

**Technical and Professional
Education**

**Curriculum Content Frameworks for
Welding Technology**

**Curriculum Content Frameworks for
Welding Technology
Developed by the
University of Arkansas at Little Rock**

**State of Arkansas
Department of Workforce Education**

NOTICE TO THE READER

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Preface

The Technical & Professional Education program continues to prepare students for employment and continuing education. To accomplish this preparation, teachers and employers have collaborated to modify individual programs to ensure that instruction is current and comprehensive. This document reflects essential competencies for program completers as well as All Aspects of the Welding Industry as required by the Carl D. Perkins Act. The Curriculum Content Frameworks for all Technical & Professional Education programs can be accessed through the Department of Workforce Education Web site.

Forward

The instructional framework for *Welding* supports courses that focus on careers in the manufacturing and construction industries. Welding courses form a specialization to prepare students for employment and continuing education in the following career role, which in turn corresponds to the CIP (Classification of Instructional Programs) code listed below.

- Career Family: Manufacturing
- Career Area: Precision Metals and Machining
- Career Role CIP Code: 48.0508
- O-NET – 51-4122.XX

Acknowledgments

The Welding Technology curriculum content framework was produced by a team of program developers from the University of Arkansas at Little Rock. A panel of experts in the field of Welding technology reviewed the framework. The format and content of the framework reflect the specific training needs within the state of Arkansas. The framework content and format is modeled after a document originally developed by a writing team under the auspices of the Virginia Department of Education. Grateful appreciation is expressed to the Virginia Department of Education and the Instructional Materials Laboratory, University of Missouri-Columbia for granting the Arkansas State's Department of Workforce Education access to their instructional frameworks.

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Introduction

About the Program

Welding prepares students for careers in manufacturing. Students who complete these courses learn, through the duties and tasks, to use gases and welding processes successfully and to braze and solder metal parts according to diagrams, blueprints, or written specifications.

The American Welding Society has developed three voluntary national skill standards for training and qualification of welding personnel: Level I – Entry Level Welder; Level II – Advanced Welder; and Level III – Expert Welder. The AWS standards along with the associated curriculum guides make up the AWS Schools Excelling through National Skill Standards Education (S.E.N.S.E.). S.E.N.S.E. information is available to any institution as part of the AWS’s commitment to provide quality education and training programs based on industry need, and to advance the science, technology and application of welding. Thus, there exists a natural connection between the Arkansas Curriculum Content Frameworks, the AWS curriculum guides and S.E.N.S.E programs.

About the Document

The Curriculum Content Framework presented here includes the following components:

- Section 1 contains a master task list for the Welding Technology program
- Section 2 contains an analysis of each task, consisting of the task, task definition, and process/skill questions to evaluate acceptable performance. All tasks have been designated essential. Essential tasks are those that must be achieved by every student pursuing the completion of the Welding Technology program.
- Section 3 lists the Arkansas Standards of Learning for language arts, mathematics, and science that are reinforced by instruction in the Welding Technology program. Academic skills in these areas are necessary for the mastery of a number of tasks performed by welders on the job.

Course Descriptions

495550 – Gas Metal Arc Welding

495560 – Gas Tungsten Arc Welding

495570 – Metal Fabrication

495580 – Shielded Metal Arc Welding

Students learn to use gases and/or welding processes and to braze and solder metal parts according to diagrams, blueprints, or written specifications. Schools may opt to become members of S.E.N.S.E., which prepares students for AWS certification.

Master Duty/Tasks Listing

Welding Technology Gas Metal ARC Welding Gas Tungsten Arc Welding Metal Fabrication Shielded Metal Arc Welding

National and state experts in the occupational field of Welding have validated the duties and tasks in this section. Each is analyzed by identifying the following:

- a *duty/task statement*, which describes what the student is to do

DUTY A: Practicing Occupational Orientation
Task:
A001: Follow safe practices.
A002: Prepare time or job cards, reports, or records.
A003: Perform housekeeping duties.
A004: Follow oral instructions to complete work assignments.
A005: Follow written details to complete work assignments.
DUTY B: Interpreting Drawing And Welding Symbols
Task:
B001: Interpret basic elements of a drawing or sketch.
B002: Interpret welding symbol information.
B003: Fabricate simple parts from a drawing or sketch.
DUTY C: Demonstrating Shielded Metal ARC Welding (SMAW)
Task:

C001: Explain the theoretical principals behind SMAW.
C002: Perform safety inspections of equipment and accessories.
C003: Identify minor external repairs to equipment and accessories.
C004: Set up for shielded metal arc welding operations and base metal preparation on carbon steel.
C005: Operate shielded metal arc welding equipment.
C006: Perform single pass fillet welds, all positions, on carbon steel.
C007: Perform V-groove welds, all positions, on carbon steel, limited thickness.
DUTY D: Demonstrating Gas Metal ARC Welding (GMAW, GMAW-S)
Task:
D001: Explain the theory behind GMAW, GMAW-S.
D002: Perform safety inspections of equipment and accessories.
D003: Identify minor external repairs to equipment and accessories.
D004: Set up for gas metal arc welding operations and base metal preparation on carbon steel.
D005: Operate gas metal arc welding equipment.
D006: Perform single pass fillet welds, all positions, on carbon steel, using short circuit transfer.
D007: Perform V-groove welds, all positions, on carbon steel, using short circuit transfer.
D008: Perform 1F-2F single pass welds on carbon steel, using spray transfer
D009: Perform 1G welds on carbon steel, limited thickness, using spray transfer.

DUTY E:
Demonstrating Flux Cored Arc Welding (FCAW-G)
Task:
E001: Explain the theory behind FCAW-G.
E002: Perform safety inspections of equipment and accessories.
E003: Identify minor external repairs to equipment and accessories.
E004: Set up for flux-cored arc welding operations and base metal preparation on carbon steel.
E005: Operate flux-cored arc welding equipment.
E006: Perform single pass fillet welds, all positions, on carbon steel.
E007: Make V-groove welds, all positions, on carbon steel.
DUTY F:
Demonstrating Gas Tungsten Arc Welding (GTAW)
Task:
F001: Explain the theory behind GTAW.
F002: Perform safety inspections of equipment and accessories.
F003: Identify minor external repairs to equipment and accessories.
F004: Set up for gas tungsten arc welding operations and base metal preparation on carbon steel, aluminum, and stainless steel.
F005: Operate gas tungsten arc welding equipment.
F006: Perform single pass fillet welds, all positions on carbon steel.
F007: Perform 1G-groove welds on carbon steel.

F008: Perform 1F–2F welds on aluminum.
F009: Perform 1G welds on aluminum.
F010: Perform 1F–3F welds on stainless steel.
F011: Perform 1G–2G welds on stainless steel.
DUTY G: Demonstrating Manual Oxyfuel Gas Cutting (OFC)
Task:
G001: Explain the theory behind OFC.
G002: Perform safety inspections of equipment and accessories.
G003: Identify minor external repairs to equipment and accessories.
G004: Set up for manual oxyfuel gas cutting operations and base metal preparation on carbon steel.
G005: Operate manual oxyfuel cutting equipment.
G006: Perform straight cutting operations on carbon steel.
G007: Perform shape-cutting operations on carbon steel.
G008: Perform bevel-cutting operations on plain carbon steel.
G009: Remove weld metal from plain carbon steel, using weld washing techniques.

DUTY H: Demonstrating Machine Oxyfuel Gas Cutting (OFC Track Burner)
Task:
H001: Explain the theory behind OFC Track Burner.
H002: Perform safety inspections of equipment and accessories.
H003: Identify minor external repairs to equipment and accessories.
H004: Set up for machine oxyfuel gas cutting (track burner) operations on carbon steel.
H005: Operate machine oxyfuel gas cutting (track burner) equipment.
H006: Perform straight-cutting operations on carbon steel.
H007: Perform bevel-cutting operations on carbon steel.
DUTY I: Demonstrating Carbon Arc Cutting (CAC-A)
Task:
I001: Explain the theory behind CAC-A.
I002: Perform safety inspections of equipment and accessories.
I003: Identify minor external repairs to equipment and accessories.
I004: Set up for manual air carbon arc cutting equipment.
I005: Operate manual air carbon arc cutting equipment.
I006: Perform metal removal operations on carbon steel.

DUTY J: Demonstrating Plasma Arc Cutting (PAC)
Task:
J001: Explain the theory behind PAC.
J002: Perform safety inspections of equipment and accessories.
J003: Identify minor external repairs to equipment and accessories.
J004: Set up for manual plasma arc cutting operations.
J005: Operate manual plasma arc cutting equipment.
J006: Perform shape cutting operations.
DUTY K: Demonstrating Visual Examination Principles and Practices
Task:
K001: Examine cut surfaces and edges of prepared base metal parts.
K002: Examine tack, intermediate layers, and completed welds.

Task Definitions

National and state experts in the occupational field of Welding have validated tasks in this section. Each task is analyzed by identifying the following:

- a *task definition* (criteria for acceptable performance), which explains what the student has to do to perform the task at the expected level of mastery
- *process/skill questions*, which assess student knowledge and performance.

Tasks are arranged by instructional duty area only. The placement of tasks into specific courses and the sequencing of tasks for instruction are local decisions based on student needs, employer demand, and school schedules.

DUTY A: Practicing Occupational Orientation
Task:
<p>A001: Follow safe practices</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • wear proper work attire such as eye and hearing protection • adhere to equipment operation standards • adhere to regulations and requirements of EPA, OSHA, and AWS concerning use, storage, and disposal of hazardous materials related to the welding industry • discuss correct applications, training, and penalties associated with each regulation/requirement, according to local ordinances and instructor's guidelines <p>Process/Skill Questions</p>
<p>A002: Prepare time or job cards, reports, or records</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • maintain accurate, clear, legible, and concise records or job cards • file documents in a timely manner for the benefit of common shop business and planning operations <p>Process/Skill Questions</p>
<p>A003: Perform housekeeping duties</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • maintain proper organization of the shop (e.g., tools, work area, and storage) on a daily basis, according to customer service standards, customer and worker safety • manage supplies and inventory <p>Process/Skill Questions</p>

A004: Follow oral instructions to complete work assignments

Definition: Process should include the following:

- Demonstrate proper listening skills to include interpreting technical and standard vocabulary, taking notes, and asking informed questions when necessary

Process/Skill Questions

A005: Follow written details to complete work assignments

Definition: Process should include the following:

- Demonstrate correct interpretation of technical writing, including blueprints, forms such as memos, work orders, and class handouts

Process/Skill Questions

**DUTY B:
Interpreting Drawing and Welding Symbols****Task:****B001: Interpret basic elements of a drawing or sketch**

Definition: Process should include the following:

- interpret basic elements of a sketch or drawing: line development, dimensions, and materials, in accordance with instructor's guidelines
- interpret a Welding Procedure Specification (WPS)

Process/Skill Questions

B002: Interpret welding symbol information

Definition: Process should include the following:

- identify basic welding symbols (e.g., fillet weld, plug weld, and lap weld), in accordance with instructor's guidelines

Process/Skill Questions

B003: Fabricate simple parts from a drawing or sketch

Definition: Process should include the following:

- identify basic fabrication components (e.g., materials, dimensions, and machine application) and fabrication of simple parts, in accordance with instructor's guidelines

Process/Skill Questions

DUTY C: Demonstrating Shielded Metal Arc Welding (SMAW)
Task:
C001: Explain the theoretical principles behind SMAW <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Explain theory behind SMAW, in accordance with the instructor's guidelines Process/Skill Questions
C002: Perform safety inspections of equipment and accessories <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Perform a visual inspection of equipment (welding leads, including ground and electrode cable) and accessories (clothing, hand tools, base metal) on a daily basis in compliance with instructor's policy. Process/Skill Questions
C003: Identify minor external repairs to equipment and accessories <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • identify accessories to include ground lead and electrode holder • identify repairs to SMAW made in accordance with manufacturers' recommendation and school policy Process/Skill Questions
C004: Set up for shielded metal arc welding operations and base metal preparation on carbon steel <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • adhere to oral or written instructions • wear protective clothing • select proper electrode • adjust to proper polarity and current • apply principles of operation in accordance with instructor's guidelines Process/Skill Questions

C005: Operate shielded metal arc welding equipment

Definition: Process should include the following:

- demonstrate proper operation of SMAW equipment by adherence to a welding assignment
- select proper material
- utilize protective clothing and accessories, in accordance with instructor's guidelines

Process/Skill Questions

C006: Perform single pass fillet welds, all positions, on carbon steel

Definition: Process should include the following:

- demonstrate single pass fillet welds by adherence to welding techniques in all positions to include electrode identification and material preparation
- use proper equipment and hand tools

Process/Skill Questions

C007: Perform V-groove welds, all positions, on carbon steel, limited thickness

Definition: Process should include the following:

- demonstrate V-groove welds by adherence to welding techniques in all positions to include electrode identification, electrode angle, material preparation
- use proper equipment and hand tools

Process/Skill Questions

**DUTY D:
Demonstrating Gas Metal Arc Welding (GMAW, GMAW-S)****Task:****D001: Explain the theory behind GMAW, GMAW-S**

Definition: Process should include the following:

- explain all applied principles of GMAW in accordance with the instructor's guidelines

Process/Skill Questions

D002: Perform safety inspections of equipment and accessories

Definition: Process should include the following:

- inspect visually GMAW, GMAW-S equipment (welding leads, which include ground and electrode cable) and accessories (clothing, hand tools, and base metal) on a daily basis, in accordance with the instructor's policy

Process/Skill Questions

D003: Identify minor external repairs to equipment and accessories

Definition: Process should include the following:

- identify visually accessories to include ground lead and electrode holder
- identify repairs to GMAW and GMAW–S made in accordance with manufacturers' recommendation and school policy

Process/Skill Questions

D004: Set up for gas metal arc welding operations and base metal preparation on carbon steel

Definition: Process should include the following:

- adhere to oral or written instructions
- wear protective clothing
- select proper electrode, adjusting to proper polarity and current
- apply principles of operation in accordance with instructor's guidelines

Process/Skill Questions

D005: Operate gas metal arc welding equipment

Definition: Process should include the following:

- demonstrate proper operation of GMAW/–S equipment by adherence to welding assignment select of proper material,
- utilize protective clothing and accessories in accordance with instructor's guidelines

Process/Skill Questions

D006: Perform single pass fillet welds, all positions, on carbon steel, using short circuit transfer

Definition: Process should include the following:

- demonstrate proper single pass fillet welds by adherence to welding techniques in both positions including wire selection, gun angle, material preparation
- use proper equipment and hand tools
- adhere to the assignment

Process/Skill Questions

D007: Perform V-groove welds, all positions, on carbon steel, using short circuit transfer

Definition: Process should include the following:

- demonstrate proper V-groove welds by adherence to welding techniques in all positions and wire selection, gun angle, and material preparation
- use proper equipment and hand tools
- adhere to the assignment

Process/Skill Questions

D008: Perform 1F–2F single pass welds on carbon steel, using spray transfer

Definition: Process should include the following:

- demonstrate proper 1F–2F single pass welds by adherence to welding techniques in both positions including wire selection, gun angle, material preparation
- use proper equipment and hand tools
- follow the assignment

Process/Skill Questions

D009: Perform 1G welds on carbon steel, limited thickness, using spray transfer

Definition: Process should include the following:

- demonstrate proper 1G welds by adherence to welding techniques in this position including wire selection, gun angle, and material preparation
- use of proper equipment and hand tools
- adhere to the assignment

Process/Skill Questions

**DUTY E:
Demonstrating Flux Cored Arc Welding (FCAW–G)****Task:****E001: Explain the theory behind FCAW–G**

Definition: Process should include the following:

- demonstrate proper V-groove welds by adherence to welding techniques in all positions and including electrode identification, electrode angle, material preparation
- use proper equipment and hand tools

Process/Skill Questions

E002: Perform safety inspections of equipment and accessories

Definition: Process should include the following:

- inspect equipment (drive rollers, contact tips, and gauges) and accessories (clothing, hand tools, base metal) daily in accordance with the instructor's policy

Process/Skill Questions

E003: Identify minor external repairs to equipment and accessories

Definition: Process should include the following:

- Identify minor repairs to FCAW equipment, such as changing contact tips, drive rollers, and gas diffusers made to manufacturers' recommendations, to school policies, and to the instructor's guidelines

Process/Skill Questions

E004: Set up for flux-cored arc welding operations and base metal preparation on carbon steel

Definition: Process should include the following:

- adhere to oral or written instructions
- wear protective clothing
- adjust to proper voltage and current
- apply principles of FCAW operation in accordance with instructor's guidelines

Process/Skill Questions

E005: Operate flux-cored arc welding equipment

Definition: Process should include the following:

- demonstrate proper operation of FCAW equipment by adherence to a welding assignment, selection of proper material, and utilization of protective clothing and accessories, in accordance with instructor's guidelines

Process/Skill Questions

E006: Perform single pass fillet welds, all positions, on carbon steel

Definition: Process should include the following:

- demonstrate fillet welds by adherence to welding techniques in accordance with instructor's guidelines

Process/Skill Questions

E007: Make V-groove welds, all positions, on carbon steel

Definition: Process should include the following:

- demonstrate V-groove welds by adhering to welding techniques in all positions in accordance with the instructor's guidelines

Process/Skill Questions

**DUTY F:
Demonstrating Gas Tungsten Arc Welding (GTAW) (Optional)**

Task:

F001: Explain the theory behind GTAW

Definition: Process should include the following:

- Explain all applied principles of GTAW in accordance with the instructor's guidelines

Process/Skill Questions

F002: Perform safety inspections of equipment and accessories

Definition: Process should include the following:

- inspect GTAW equipment, shielding gas equipment, and accessories (clothing, hand tools, and base metal on a daily basis in accordance with the instructor's policy

Process/Skill Questions

F003: Identify minor external repairs to equipment and accessories

Definition: Process should include the following:

- identify minor repairs to GTAW equipment such as changing cups and collets

Process/Skill Questions

F004: Set up for gas tungsten arc welding operations and base metal preparation on carbon steel, aluminum, and stainless steel

Definition: Process should include the following:

- adhere to oral or written instructions
- wear protective clothing
- select proper electrode
- adjust to proper polarity and current
- apply principles of GTAW operation in accordance with instructor's guidelines

Process/Skill Questions

F005: Operate gas tungsten arc welding equipment

Definition: Process should include the following:

- demonstrate proper operation of GTAW welding equipment by adherence to welding assignment
- select proper material
- identify filler metals, tungsten electrodes, and shielding gases
- utilize protective clothing and accessories in accordance with instructor's guidelines

Process/Skill Questions

F006: Perform single pass fillet welds, all positions on carbon steel

Definition: Process should include the following:

- demonstrate sound fillet welds in all positions in accordance with instructor's guidelines

Process/Skill Questions

F007: Perform 1G–groove welds on carbon steel

Definition: Process should include the following:

- demonstrate sound 1G-groove welds in the flat position in accordance with the instructor's guidelines

Process/Skill Questions

F008: Perform 1F–2F welds on aluminum

Definition: Process should include the following:

- demonstrate sound 1F–2F groove welds in the flat position in accordance with the instructor's guidelines

Process/Skill Questions

F009: Perform 1G welds on aluminum

Definition: Process should include the following:

- demonstrate sound 1G–groove welds in the flat position in accordance with the instructor's guidelines

Process/Skill Questions

F010: Perform 1F–3F welds on stainless steel

Definition: Process should include the following:

- demonstrate sound 1F–3F groove welds in the flat position in accordance with the instructor's guidelines

Process/Skill Questions

F011: Perform 1G–2G welds on stainless steel

Definition: Process should include the following:

- demonstrate sound 1G–2G welds in the flat position in accordance with the instructor's guidelines

Process/Skill Questions

DUTY G:
Demonstrating Manual Oxyfuel Gas Cutting (OFC)

Task:

G001: Explain the theory behind OFC

Definition: Process should include the following:

- explain all applied principles of OFC in accordance with the instructor's guidelines

Process/Skill Questions

G002: Perform safety inspections of equipment and accessories

Definition: Process should include the following:

- inspect OFC equipment and accessories (clothing, hand tools, and base metal) on a daily basis in accordance with the instructor's policy

Process/Skill Questions

G003: Identify minor external repairs to equipment and accessories

Definition: Process should include the following:

- identify minor repairs required for safe operation of OFC equipment
 - check hoses for leaks
 - ensure gauges are in proper working order
 - ensure that tip is free of obstruction

Process/Skill Questions

G004: Set up for manual oxyfuel gas cutting operations and base metal preparation on carbon steel

Definition: Process should include the following:

- adhere to oral or written instruction
- wear protective clothing
- select proper electrode
- assemble components (gauges, hoses, torch, cutting tip), adjusting to proper polarity and current
- apply principles of oxyfuel gas cutting operation in accordance with instructor's guidelines

Process/Skill Questions

G005: Operate manual oxyfuel cutting equipment

Definition: Process should include the following:

- demonstrate proper operation of manual oxyfuel cutting equipment by adherence to welding assignment
- adjust equipment to obtain a neutral flame
- examine cut surfaces
- identify types of gases and flames
- discuss proper shut-down of equipment
- utilize protective clothing accessories in accordance with instructor's guidelines

Process/Skill Questions

G006: Perform straight cutting operations on carbon steel

Definition: Process should include the following:

- produce a straight production cut surfaced according to the specifications based on the instructor's guidelines

Process/Skill Questions

G007: Perform shape-cutting operations on carbon steel

Definition: Process should include the following:

- produce a shape cut to the specifications of the instructor, or to those specified by a drawing

Process/Skill Questions

G008: Perform bevel-cutting operations on plain carbon steel

Definition: Process should include the following:

- bevel cut should be performed to the instructor's specifications, or to those as specified by a drawing

Process/Skill Questions

G009: Remove weld metal from plain carbon steel, using weld washing techniques

Definition: Process should include the following:

- remove weld metal from plain carbon steel in accordance with instructor's guidelines

Process/Skill Questions

DUTY H: Demonstrating Machine Oxyfuel Gas Cutting (OFC Track Burner)
Task:
H001: Explain the theory behind OFC track burner <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • explain all applied principles of OFC track burner in accordance with the instructor's guidelines Process/Skill Questions
H002: Perform safety inspections of equipment and accessories <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • inspect OFC equipment and accessories (clothing, hand tools, base metal) • check hoses for leaks or damage • ensure track is free of obstruction • inspect electrical cords and gauges on a daily basis in accordance with the instructor's policy Process/Skill Questions
H003: Identify minor repairs to equipment and accessories <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • identify minor repairs required for safe operation of OFC track burner equipment • ensure gauges are in proper working order • ensure tip is free of obstruction in accordance with instructor's guidelines Process/Skill Questions
H004: Set up for machine oxyfuel gas cutting (track burner) operations on carbon steel <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • adhere to oral or written instruction • wear protective clothing • assemble components (e.g. gauges and hoses) • apply principles of OFC operation in accordance with instructor's guidelines Process/Skill Questions

H005: Operate machine oxyfuel gas cutting (track burner) equipment

Definition: Process should include the following:

- demonstrate proper operation of machine OFC (track burner) equipment by adherence to a welding assignment
- adjust equipment to obtain a neutral flame
- adjust travel speed
- identify types of cuts (e.g. bevel, straight)
- cut metal to a designated thickness
- shut down equipment in accordance with instructor's guidelines

Process/Skill Questions

H006: Perform straight-cutting operations on carbon steel

Definition: Process should include the following:

- produce a straight cut surface according to instructor's specifications

Process/Skill Questions

H007: Perform bevel-cutting operations on carbon steel

Definition: Process should include the following:

- produce a bevel-cut surface to the instructor's specifications

Process/Skill Questions

DUTY I: Demonstrating Carbon Arc Cutting (CAC-A)

Task:

I001: Explain the theory behind CAC-A

Definition: Process should include the following:

- Explain all applied principles of CAC-A in accordance with the instructor's guidelines

Process/Skill Questions

I002: Perform safety inspections of equipment and accessories

Definition: Process should include the following:

- inspect CAC-A equipment and accessories (clothing, hand tools, base metal)
- check for moisture in the air compressor lines
- inspect electrical cords and gauges on a daily basis according to instructor's policy

Process/Skill Questions

I003: Identify minor external repairs to equipment and accessories

Definition: Process should include the following:

- identify minor repairs required for safe operation of CAC-A equipment
- check for moisture in the air compressor lines
- ensure gauges are in proper working order
- identify frayed, nicked, or loose connectors in accordance with the instructor's guidelines

Process/Skill Questions

I004: Set up for manual air carbon arc cutting equipment

Definition: Process should include the following:

- demonstrate proper setup of manual CAC equipment using basic CAC theory (e.g., setting the proper air pressure, amperage, and polarity for electrode size and correct grounding to work piece)
- install carbon electrode into the torch line using correct extension
- position air holes
- commence operations by turning the air release button to "on," in accordance with instructor's guidelines

Process/Skill Questions

I005: Operate manual air carbon arc cutting equipment

Definition: Process should include the following:

- demonstrate proper operation of manual CAC equipment by adhering to welding assignment utilize protective clothing and accessories
- start and maintain an arc on carbon steel in accordance with instructor's guidelines

Process/Skill Questions

I006: Perform metal removal operations on carbon steel

Definition: Process should include the following:

- perform carbon arc cutting to remove weld metal and separating structural members for salvage in accordance with instructor's guidelines

Process/Skill Questions

DUTY J: Demonstrating Plasma Arc Cutting (PAC)
Task:
J001: Explain the theory behind PAC <i>Definition:</i> <ul style="list-style-type: none"> Explain all applied principles of PAC in accordance with the instructor's guidelines Process/Skill Questions
J002: Perform safety inspections of equipment and accessories <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> inspect PAC equipment (power source, air compressors, connections to the PAC process) and accessories (clothing, hand tools, base metal) daily check for moisture in the air compressor lines daily in accordance with the instructor's policy Process/Skill Questions
J003: Identify minor external repairs to equipment and accessories <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> identify electrical wiring (checking for frayed, nicked, or loose connections) identify air compressor (lines cleared of moisture) identify plasma torch (condition of nozzle and tip) in accordance with instructor's guidelines Process/Skill Questions
J004: Set up for manual plasma arc cutting operations <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> adhere to verbal or written instruction wearing protective clothing assemble components including correct air compressor pressure selection and shielding as it pertains to metal thickness select amperage or machine setting ground power source install torch head parts apply principles of PAC operation in accordance with instructor's guidelines Process/Skill Questions

J005: Operate manual plasma arc cutting equipment

Definition: Process should include the following:

- demonstrate proper operation of manual plasma arc cutting equipment by adhering to welding assignment
- utilize protective clothing and accessories
- start and maintain the plasma arc on carbon steel in accordance with the instructor's guidelines

Process/Skill Questions

J006: Perform shape cutting operations

Definition: Process should include the following:

- perform straight and shape cuts, in accordance with instructor's guidelines

Process/Skill Questions

**DUTY K:
Demonstrating Visual Examination Principles and Practices****Task:****K001: Examine cut surfaces and edges of prepared base metal parts.**

Definition: Process should include the following:

- demonstrate visual examination of surfaces of material for serious notches, grooves, or gouges

Process/Skill Questions

K002: Examine tack, intermediate layers, and completed welds.

Definition: Process should include the following:

- demonstrate visual inspection of tacks and welds for defects and discontinuities (e.g., undercut, slag inclusion, and overlap)

Process/Skill Questions

SkillsUSA

Task Definitions

DUTY A: Self - Improvement
Task:
A001: Complete a self-assessment and identify individual learning styles <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Identify and list individual strengths. • Identify and list areas in need of improvement. Process/Skill Questions
A002: Discover self-motivation techniques and establish short-term goals <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Develop a list of short-term goals. • Discuss ways to change or improve lifestyle appearance and behavior. Process/Skill Questions
A003: Determine individual time-management skills <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Prepare and keep a time journal. • Discuss ways to improve time management skills. Process/Skill Questions
A004: Define future occupations <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Search internet for career opportunities within specified fields of study. • Prepare presentation on a specified career area. Process/Skill Questions
A005: Develop awareness of cultural diversity and equity issues <i>Definition:</i> Process should include the following: <ul style="list-style-type: none"> • Research a tradition modeled by individual's family. • Develop personal philosophy statements regarding gender equity. Process/Skill Questions

<p>A006: Define the customer</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Differentiate between External and Internal customers • Discuss factors which contribute to poor customer relationships. <p>Process/Skill Questions</p>
<p>A007: Recognize benefits of doing a community service project</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Discuss and list ways to become involved in the community • Develop a community service project. <p>Process/Skill Questions</p>
<p>A008: Demonstrate effective communication with others</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Identify and list personal barriers to listening. • Develop personal plan to overcome barriers to listening. <p>Process/Skill Questions</p>
<p>A009: Participate in a shadowing activity</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Summarize experience of job shadowing activity. <p>Process/Skill Questions</p>
<p>A010: Identify the components of an employment portfolio</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Identify parts of a portfolio • Design a personal employment portfolio <p>Process/Skill Questions</p>
<p>A011: List proficiency in program competencies</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Complete an interpersonal competency assessment. <p>Process/Skill Questions</p>
<p>DUTY B: Civic, Social and Business Awareness</p>
<p>Task:</p>

B001: Measure/modify short-term goals

Definition: Process should include the following:

- Discuss steps to pursue short-term goal(s)

Process/Skill Questions

B002: Identify stress sources

Definition: Process should include the following:

- List personal sources of stress.
- Discuss techniques to cope with individual sources of stress.

Process/Skill Questions

B003: Select characteristics of a positive image

Definition: Process should include the following:

- Discuss actions and traits that lead to a positive image.
- Discuss actions and traits that lead to a negative image.

Process/Skill Questions

B004: Demonstrate awareness of government, professional organizations and trade unions

Definition: Process should include the following:

- Identify state governor, legislators, and senators.
- Identify professional organizations pertaining to specific career areas.

Process/Skill Questions

B005: Apply team skills to a group project

Definition: Process should include the following:

- Form a team to develop a class project.

Process/Skill Questions

B006: Observe and critique a meeting

Definition: Process should include the following:

- Attend a formal meeting held within the community
- Critique the attended meeting.

Process/Skill Questions

B007: Demonstrate business meeting skills

Definition: Process should include the following:

- List and discuss the basic rules to ensure an orderly and business-like meeting
- Role-play appropriate meeting skills

Process/Skill Questions

B008: Demonstrate social etiquette

Definition: Process should include the following:

- Role-play appropriate social behavior
- Differentiate between good and bad manners.

Process/Skill Questions

B009: Complete survey for employment opportunities

Definition: Process should include the following:

- Gather information on a particular employment opportunity of interest.
- Conduct internet search of a specific career area.

Process/Skill Questions

B010: Review a professional journal and develop a 3 to 5 minute presentation

Definition: Process should include the following:

- Develop a presentation on the content, purpose, and distribution of a particular professional journal

Process/Skill Questions

B011: Identify customer expectations

Definition: Process should include the following:

- List and discuss customer expectations.
- Discuss consequences of unmet customer expectations.

Process/Skill Questions

B012: Complete a job application

Definition: Process should include the following:

- Obtain a job application from various businesses in the community
- Conduct a mock job interview.

Process/Skill Questions

B013: Identify a mentor

Definition: Process should include the following:

- Define mentor.
- Discuss ways in which a mentor can help an individual meet career goals.

Process/Skill Questions
<p>B014: Assemble your employment portfolio</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Develop employment portfolio <p>Process/Skill Questions</p>
<p>B015: Explore supervisory and management roles in an organization</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Examine an organizational chart • Discuss responsibilities of managers and supervisors <p>Process/Skill Questions</p>
<p>B016: Recognize safety issues</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Discuss safety issues within a given career area <p>Process/Skill Questions</p>
<p>B017: Evaluate your proficiency in program competencies</p> <p><i>Definition:</i> Process should include the following:</p> <ul style="list-style-type: none"> • Define task and competency • List competencies associated with a specified career area. <p>Process/Skill Questions</p>

Technical And Professional Curriculum Frameworks

Purpose

This section of the framework contains material to help instructors in technical and professional programs to reinforce basic skills in the areas of Reading and Writing, Math and Science. The technical portion of this guide takes a more direct approach by using specific duty and task listings, but changes in the academic section lead in a more general direction. The reason for this is simple: all good instructors do not teach in the same way. However, all good instructors share the trait of being able to connect their material to everyday life. For example, understanding concepts related to heat, are important for cosmetology students as well as lathe operators in manufacturing plants. However, each program will probably take a different approach in the amount of detail and examples relating to heat concepts. Both groups require basic science knowledge of principles relating to heat, but the application of the principles will be different.

Basic Skills: The Content Areas

Included in this guide are materials to support basic skills in Reading and Writing, Mathematics, and Science. The overall approach taken here is a move toward problem-solving skills. By problem-solving, we mean the ability to take information and use it for a purpose: to take action, make decisions, predict outcomes, suggest improvements. Another term for these thinking skills is a general “literacy.”

Literacy skills have always been in demand in the workplace. A quick review of workplace training programs and other literature regarding adult education demonstrates that the need for a literate workforce is still one of the most pressing problems employers face today. Indeed, many employers (from small- and medium-sized businesses to Fortune 500 companies) have spent hundreds of millions of dollars on in-house basic skills training programs.

What constitutes a literate workforce? There are many definitions for literacy and hundreds of tests that measure it, but when employers are asked what they're looking for in potential new hires, the answers are general: they want individuals who can read and write; show up on time; think and solve problems, and keep their personal lives in order (that is, don't bring a drinking problem into the workplace).

Viewed in this way, the words "literacy" and "literate" are good terms for what educators are trying to instill in their students, the future workforce. The more common definition (being able to read and write) is certainly appropriate but the additional definitions (knowledgeable, educated, well-informed) are also apt. It is this broad term, "literate," that we use to guide instructors on what to cover in the classroom. No matter which vocational-technical area is being focused on, no matter how technical the terminology is, instructors are given the task of helping students take information, break it down into necessary parts, process details, and be able to come away with an understanding of some sort. This is "literacy", and the process is the same for every subject area-- teaching students how to think and solve problems.

Format

Each section includes a two-column table. Skills are listed on the left side; suggestions for implementing these skills into the curriculum are listed on the right side. Each suggestion is written in such a way that it can be tailored to most vocational-technical programs.

Using The Guide

This guide was prepared with four concepts in mind:

- The instructor is *aware of the need* for students to improve their basic skills.
- The instructor is the *best-qualified person* to decide how to include this material in the classroom or lab. The students' abilities and needs should drive the instructor in deciding how to use, expand, or modify these topics.
- The instructor *already has curriculum that works* for his or her students. Therefore, the suggestions for reinforcing basic skills
 - must be easy to implement
 - must stand alone

- do not need to be taught in a particular order
 - must be open-ended enough to be useful for any technical/vocational program.
- ***Time is limited.*** Unless there are quick ways to reinforce basic skills, changes to the curriculum will not be made. Teaching basic skills in the context of technical material will help students make connections that are more memorable, and will require no additional lesson planning. Just as instructors incorporate updates in technical knowledge, they can add basic skills concepts as well. Adding a few concepts at a time will help students perform better in the lab as well as on tests and evaluations.

Methods

The following methods may help instructors decide how to increase basic skill knowledge:

- *Collaborative projects*- how could a joint project between regular education teachers and vocational instructors reinforce concepts for both programs?
- *Outside assignments*- would students benefit from an outside assignment explaining how a basic math (science, reading) concept ties to a process in the lab?
- *Extra credit*- students needing extra credit can research outside topics and turn in a short summary of material
- *“Need-to-know” assignments*- Students prepare a bulleted list of the basic concepts in science they need to know in order to correctly perform ____ operation in the lab.
- *Question of the Day*- a few daily math problems for students to answer at the beginning of class allows the instructor to set the tone for the material. It also gives students an immediate goal when they enter the classroom and teaches them to stay on task. Bonus points may be awarded at the end of the week, quarter, semester, etc.
- *Two-minute Oral Presentations*- students who need to practice speaking skills can be asked to give a two-minute oral presentation at the end of class summarizing the main points for the day. Or, a two-minute presentation at the beginning of class can recap the material from a previous class.
- *Connecting with Workers*- students can poll parents, friends, area employers or other persons to find out the top 5 basic science skills needed on the job.

- *Direct Questioning*- include a few basic knowledge questions in a presentation. Award points to groups based on correct answers.

Resources

In creating the Academic Reinforcement material for the technical and professional frameworks, we used a number of source documents and resources.

- The English Language Arts, Science, and Mathematics components of the *Curriculum Improvement Project* by Dr. Willard Daggett were consulted to ensure that the top-ranked skills in those areas would be reflected in the academic support material. The English Language Arts and Science components have many linkages to the material included here. (The higher-level math skills such as trigonometry were not included in this document.)
- Data from work with Arkansas employers- the Workplace Skills Enhancement Program (WSEP) at the University of Arkansas at Little Rock (UALR) has completed many training projects and job profiles for employers in Arkansas. Our constant contact with workers and employers provides a tremendous amount of data that we use in designing customized training programs and in working on projects such as curriculum frameworks. Also, the staff of WSEP has experience teaching in Arkansas public schools, the US military, and the Job Corps.
- Additionally, other groups within UALR (the Labor Education Program, the Institute for Economic Advancement and the College of Business) provide resources regarding health and safety information, labor unions and their role in the workplace, computer and information technology and other training and outreach program data.
- US Department of Labor- the US DOL has many online documents and publications that support workers and issues regarding the workplace. (Work by Philippi and Greenan, 1988 on workplace skills was especially helpful.) Visit the website at www.dol.gov.
- Occupational Safety and Health Administration (OSHA) provides online and other resources for instructors and professionals. For topics relating to safety and health, visit www.osha.gov.

- Multistate Academic and Vocational Curriculum Consortium (MAVCC) is an organization that develops competency-based curriculum. For more on MAVCC see www.mavcc.org.

ACADEMIC STANDARDS FOR READING AND WRITING

Strategies for Reinforcement in the Vocational-Technical Classroom

Note:

* indicates industry-related materials, handouts, notes, etc.

Objective	Classroom Applications to Industry
<p><i>Present, Review and Discuss, Master</i> the list of skills employers want for the workplace regarding reading and writing.</p>	<p>Use the list of skills employers want to introduce students to the requirements of the workplace.</p> <p>Depending on students' ability levels, any of the following methods may be used to increase their understanding of the concepts:</p> <ul style="list-style-type: none"> • Discussion • Interviewing parents or other adults in the workplace about the skills required • Interviewing employers about the skills in terms of importance • Identifying workplace situations in which certain skills become more important than others • Researching adult education programs to learn why deficits in these areas must be remediated, and the cost spent yearly on these programs • Researching the topic of adult literacy
<p><i>Answer</i> simple comprehension or recall questions from a lecture or from written material.</p>	<p>Provide 2 examples of workplace materials* on students' reading level.</p> <p>With the first, allow students to read information and then answer brief recall questions.</p> <p>With the second example, read aloud the material but do not give a handout. Ask brief recall questions.</p> <p>Compare the differences...how do students retain information better—orally or visually? Discuss learning styles and impact on the job.</p>
<p><i>Follow, Give</i> oral instructions.</p>	<p>Using instructions for a hands-on task, have students give <u>oral</u> instructions to a partner or group. Rate the effectiveness of the speaker.</p>

<i>Follow, Give written instructions.</i>	Using a short list of instructions for a hands-on task, have students give <u>written</u> instructions to a partner or group. Rate the effectiveness of the speaker.
<i>Show the difference between relevant and irrelevant details.</i>	Using a copy of workplace materials*, students underline relevant or important details in red, irrelevant or less important details in blue.
<i>Sort objects based on x number of criteria.</i>	Using workplace materials*, sort a group of objects based on characteristics identified by instructor (e.g., by color, shape, defect, or a combination of these).
<i>Recognize, Identify technical vocabulary.</i>	Using workplace materials*, highlight technical vocabulary terms. Create a class dictionary of industry-related technical vocabulary. Students may add illustrations or diagrams. Each student receives a copy of the final product. Emphasize skills such as alphabetical order, guidewords, prefixes, suffixes, and pronunciation guides.
<i>Read aloud.</i>	Read aloud from workplace materials* in groups or individually.
<i>Identify, Explain symbols, abbreviations and acronyms relevant to subject area.</i>	Using workplace materials*, highlight symbols, abbreviations, and acronyms. Create a table with one column for each of symbols, abbreviations, acronyms. Classify each one and write in the meaning.
<i>Understand, Use rules of grammar, usage, spelling, punctuation.</i>	Identify the missing punctuation mark, misspelled word, incorrect use of grammar from workplace materials*. Correct the mistakes.
<i>Discuss uses and purposes of a variety of workplace communication tools.</i>	Find examples of a business letter, memo, report, brochure, proposal, schematic, map, and diagram.
<i>Duplicate process demo by instructor</i>	Using a workplace process, demonstrate steps

	to complete and have students perform individually or in groups.
<i>Notice,</i> Apply word analysis techniques.	Using workplace materials*, identify prefixes, suffixes, or roots that indicate meaning (e.g. therma = heat) ¹
Match parts from photographs or diagrams to actual objects.	Using workplace materials*, follow a sequence of pictures or diagrams to build, create, or copy an item or process.
Read for main ideas and for details.	Use a graphic organizer ¹ to show main ideas and supporting details.
Distinguish between fact, opinion, and inference.	Collect examples of materials based on fact or opinion/inference. Ask students to underline key terms that indicate the presence of facts or opinions.
Distinguish between rows and columns; identify a cell as a block where a row and column intersect.	Using charts or tables from workplace materials*, discuss the reasons for this format. Identify the quantity in a particular cell.
<i>Select,</i> Use appropriate resources and reference tools.	Explain the uses for the following: Dictionary, Thesaurus, Almanac, Atlas, Card Catalog, Encyclopedia. List reasons for choosing one reference tool over another. Use reference tools to answer questions related to industry or current events.
Paraphrase written or oral material into summary form.	Using workplace materials*, determine the best way to condense or shorten the material so as to give an overview to a layperson. Using a set of guidelines appropriate to students' level in length and detail, summarize the information into bullet points.

<p><i>Interpret,</i> <i>Fill out/complete forms and records.</i></p>	<p>Using workplace materials*, answer basic questions (e.g., summarize the list of parts from an inventory).</p> <p>Using blank forms or documents, fill in details. Pay close attention to directions. Students critique work with partner.</p> <p>Create a form or document to be used in a workplace process.</p>
<p><i>Use,</i> <i>Develop a process for remembering details.</i></p>	<p>Use pneumatic devices to organize and remember details. Pneumatic devices¹ include Semantic Maps, Thought Webs, and other creative tools to organize thinking.</p>
<p><i>Proofread,</i> <i>Correct mistakes in written drafts.</i></p>	<p>Using a newspaper article, locate and mark mistakes in grammar, punctuation, or usage.</p> <p>Correct mistakes in written drafts.</p>
<p><i>Examine different types of writing used in the workplace (reports, memos, brochures, logs, blueprints, formulas, etc).</i></p>	<p>Gather samples of workplace materials*. Identify each by type.</p> <p>Compare and contrast the difference between audience, (who the document is written for) length, background information/education needed to understand material, level of detail, organization and layout of the document.</p>
<p><i>Understand the writing process.</i></p>	<p>In order to apply the writing process, create a workplace communication tool to be used for a specific purpose.</p> <p>Prewrite: Brainstorm, gather facts, or do research to create a <u>business letter, memo, report, brochure, proposal, schematic, map, or diagram.</u></p> <p>Identify the audience.</p>

	<p>Determine the purpose of the document.</p> <p>Write: Create a first draft.</p> <p>Revise and Edit: Make changes to ensure accuracy.</p> <p>Look at the writing from a different point of view.</p> <p>Shorten or make more concise where possible.</p> <p>Use white space, bold print and other formatting details to make the document easy-to-read.</p> <p>Publish: Decide on the best format for the final copy (size, type of material, layout, graphics, etc.)</p> <p>Publish the final draft.</p>
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<p><i>Identify,</i> Create sentences of different types.</p>	<p>Using workplace materials*, find sentences of varying types. Examples include Simple Sentences (subject + predicate) Complex Sentences (subject + predicate including clauses).</p> <p>Write sentences, paragraphs, or essays using sentences of different types (e.g., write a 2-paragraph summary of today's lesson).</p>
<p><i>Identify,</i> Use contractions correctly.</p>	<p>Using workplace materials*, locate contractions (e.g., isn't, I'll).</p> <p>Identify misuses of contractions.</p> <p>Write a short list of directions relating to an industry process and use as many contractions as possible.</p>
<p><i>Identify,</i> Use correctly commonly misspelled words.</p>	<p>Using a list of commonly misspelled words¹, locate errors in the media (newspaper articles, Internet sites, magazines.)</p> <p>Ask each student to identify his problem words from the list.</p> <p>Attempt to incorporate problem words into class activities (e.g., add them to a list of work instructions).</p> <p>Give short weekly quizzes focusing on 5 words per week. Award bonus points.</p>
<p><i>Identify,</i> Use correctly the English irregular verbs.</p>	<p>From a list of irregular verbs, review the uses of each.</p> <p>Ask each student to identify his problem irregular verbs from the list.</p> <p>Attempt to incorporate problem verbs into class activities, such as making a collection of mistakes from print.</p>
<p><i>Identify,</i> Use Signal Words and other cues to improve writing.</p>	<p>Use a list of Signal Words¹ and discuss their purpose in writing (signal words are words that raise a flag to a reader to pay attention.)</p>

	<p>Examples: Signal Words showing emphasis: Most of all, It should be noted, Of course</p> <p>Signal Words showing a conclusion: Lastly, In summary, Finally</p> <p>Identify common signal words in workplace writing, especially in sequenced lists.</p> <p>Write a list of work instructions using signal words.</p>
Identify components of workplace documents such as blueprints, schematics, floor plans, and other industry-related documents.	Label the parts of a workplace document.
Place steps in proper sequence.	Using a list of steps or pictures cut them apart so that students can place them in the proper order.
Analyze cause and effect.	Experiment with cause and effect in the classroom (e.g., change the sequence of events in a process).
Determine missing information.	<p>Locate the information that is missing from a problem and explain why the problem cannot be solved without it.</p> <p>To reinforce concepts, use a completed problem and remove the important details. Ask students if they can identify what's missing.</p>
Differentiate between tools used for a job.	Given a list of tools and a list of functions, identify the most efficient tool for each task.
Assemble or disassemble objects.	<p>From a list of oral or written instructions, assemble an object or complete a process.</p> <p>Students write the instructions for disassembly.</p>
Cross-reference materials to compare information.	Using more than one source document, compare the information given.

<i>Interpret reasoning behind rules or regulations.</i>	Using workplace materials*, make a list of possible reasons or justifications for a safety guideline, regulation, etc.
<i>Show contrasts between approaches.</i>	<p>Given a workplace scenario, write a brief approach to solving the problem. (Working in groups would be beneficial.)</p> <p>Compare and contrast each approach from the perspective of a worker, manager, supervisor.</p>
<i>Organize data in a new format.</i>	Using workplace materials*, organize the information into a new format.
<i>Prove a rule or method's sufficiency.</i>	Perform an experiment to determine how much tolerance is acceptable in a case study, (e.g., find the range of drops of red dye sufficient to match the standard red color used in latex paint).
<i>Show relationships between two or more systems.</i>	Using 2 or more partners related to industry, show or explain how they are interrelated (e.g., explain the relationship between social workers and hospitals).
<i>Given examples of emergency situations, identify real world course of action.</i>	Using an emergency situation common to your industry, outline a step-by-step plan for action.
<i>Identify variables that affect the outcome of a process.</i>	Experiment with or predict variables that affect the outcomes for a process (e.g., weather patterns that adversely affect a process, such as building a road).
<i>Infer situations that meet guidelines when complete information is not available.</i>	<p>Given a policy or industry standard that has debatable interpretations, list possible situations that can arise that do not have clear solutions in the policy.</p> <p>Discuss or debate the issues.</p>
<i>Compare finished products to a set of guidelines.</i>	Compare a set of objects to a set of guidelines (e.g., analyze a batch of parts and document how they do or do not meet a set of Quality Assurance guidelines).

	List any discrepancies (parts that do not meet guidelines) and categorize them by type (e.g., burns, holes, etc).
<i>Identify preventative measures for maintenance of a system.</i>	List the needed routine maintenance to keep a system working properly.
<i>Predict new standards or rules that may become necessary in the future.</i>	Identify recent areas of change or development in your industry. Discuss potential future needs or developments that may occur (e.g., potential need for better training requirements for airport personnel).
<i>Improve a process by streamlining (locating waste) or decreasing lost time.</i>	Examine a process in industry in step-by-step detail. Suggest ways to decrease time needed or make the process more efficient. Isolate the cause of failure in a process by performing an experiment.
<i>Prepare a model explaining a concept.</i>	Build, draw, or create a model that explains a concept (e.g., show a need for environmental standards for water or air pollution).

¹ Fry, Edward; Kress, Jacqueline; Fountoukidis, Dona. *Reading Teacher's Book of Lists*, 4th ed. ISBN 0-13-028185-9.

ACADEMIC STANDARDS FOR MATHEMATICS

Strategies for Reinforcement in the Vocational-Technical Classroom

Note:

* indicates industry-related materials, handouts, notes, etc.

Topics Listing

Problem Solving

Operations and Calculations

Applications

Data Analysis and Display

Objectives	Classroom Applications to Industry
<p><i>Present</i> <i>Review and Discuss</i> Master the list of skills employers want for the workplace regarding mathematics.</p>	<p>Use the list of skills employers want to introduce students to the requirements of the workplace.</p> <p>Depending on students' ability levels, any of the following methods may be used to increase their understanding of the concepts:</p> <ul style="list-style-type: none"> • Discussion • Interviewing parents or other adults in the workplace about the skills required • Interviewing employers about the skills in terms of importance • Identifying workplace situations in which certain skills become more important than others • Researching adult education programs to learn why deficits in these areas must be remediated, and the cost spent yearly on these programs • Researching the topic of adult literacy
PROBLEM SOLVING	
<p><i>Examine</i> Apply problem-solving process.</p>	<p>Define the problem What is being asked? Decide on a type of solution Multi-step or single-step question? Try any of these: Estimate an answer Draw a diagram Find a pattern</p>

	<p> Guess and check Logical Reasoning Make a graph Make an organized list Make a table Solve a simpler problem Use a simulation Work backwards Write an equation </p> <p> Locate information you need Do you have all the components? </p> <p> Get missing information May need to perform some other calculations </p> <p> Calculate Look at the answer. How should the remainder be expressed? </p> <p> Check the solution Is it reasonable? </p>
OPERATIONS AND CALCULATIONS	
<i>Read, write, and count numbers.</i>	<p>Read and write numbers (especially focus on very large and very small numbers where mistakes are common).</p> <p>Give a weekly quiz asking students to compare and sequence numbers. Example: 0.4445 ____ 0.4455 > or <</p> <p>Put these in order from smallest to largest: 0.66, 0.677, 0.67</p>
<i>Round numbers.</i>	<p>Discuss your industry's use of decimals.</p> <p>Identify the place values needed to adequately perform a job. For example, a Quality Assurance Technician who works on the line in a manufacturing plant may need to use numbers through the ten-thousandths decimal place.</p>

	Take a series of sample measurements, and round them to the nearest decimal place identified by the instructor.
<i>Estimate numbers.</i>	<p>The skill of making close estimations is tied to understanding accuracy.</p> <p>Discuss real-life situations where estimation is used.</p> <p>Discuss the practice of estimation before calculation. Regular practice in estimating before calculating will teach students where they make errors and will increase their estimation skills.</p> <p>Discuss work situations where estimation skills are required, and possible consequences of making estimation errors (for example, is an estimate appropriate for inventory purposes? For ordering supplies?)</p>
<i>Compute averages.</i>	<p>Discuss averages in general terms. Calculate the average temperature, average rainfall or precipitation, average number of students per class, and other relevant examples.</p> <p>Using workplace materials*, calculate a series of averages.</p> <p>For example:</p> <ul style="list-style-type: none"> • Take 10 different measurements of a piece of pipe using a micrometer. • Compare the measurements. • Find the average of all the measurements. • Compare the average to the smallest and largest measurement. • Discuss the effects on quality...when is an average an acceptable benchmark measurement?
<i>Calculate with whole numbers: perform one-step problems with basic operations.</i>	Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of addition, subtraction, multiplication, and division.
<i>Perform problems that require an</i>	Using workplace materials*, make a list of

<p>understanding of the order of operations.</p>	<p>situations or problems that need more than one step to perform them.</p> <p>If the procedures (add, subtract, multiply, divide, etc) are on the same level of importance, such as adding or subtracting, then the order of operations will not impact the way the problem is solved.</p> <p>If a problem requires more than one level of operation to solve (example, dividing and adding), work the problem correctly by performing the division part first and then the addition.</p> <p>Rework the problem using addition first. Compare the answers.</p> <p>Discuss the importance of reasoning skills to verify that an answer makes sense.</p>
<p><i>Understand the relationship between decimals, fractions and percents.</i></p>	<p>Make a table comparing fractions, decimals, and percents.</p>
<p><i>Compute with fractions, decimals, and percents, and show understanding of the relationship between them.</i></p>	<p>Create sample problems using fractions that relate to everyday situations.</p> <ul style="list-style-type: none"> ▪ Poll the class on interesting topics (favorite food). Convert whole numbers to fractions. Votes- Pizza- 10 Salad- 2 BBQ- 8 <p>$10+2+8 = 20$ (recognize denominator value)</p> <p>$\frac{10}{20}$ Pizza $\frac{2}{20}$ Salad $\frac{8}{20}$ BBQ</p> <ul style="list-style-type: none"> ▪ Add the fractions. <p>$\frac{10}{20} + \frac{2}{20} + \frac{8}{20} = \frac{20}{20}$</p> <ul style="list-style-type: none"> ▪ Convert fraction to whole number. (Total answers equal 1 class's worth of answers.)

	$\frac{10}{20} + \frac{2}{20} + \frac{8}{20} = \frac{20}{20} = 1$ <ul style="list-style-type: none"> Convert fractions to percents. $\frac{10}{20} \text{ means } 10 \text{ divided by } 20 = 0.50$ <p>Move decimal 2 places right. $0.50 = 50\%$</p> $\frac{2}{20} \text{ means } 2 \text{ divided by } 20 = 0.10$ <p>$0.10 = 10\%$</p> $\frac{8}{20} \text{ means } 8 \text{ divided by } 20 = 0.40$ <p>$0.40 = 40\%$</p> <p>$50\% + 10\% + 40\% = 100\%$ Notice the totals add to 100%.</p> <p>So, $\frac{20}{20} = 1 = 100\%$</p> <p>Using workplace materials*, calculate work-related questions using fractions, decimals, and percents.</p> <p>Calculate shipping costs for internet purchases (such as music from amazon.com).</p>
<i>Solve formulas and equations.</i>	<p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of equations.</p> <ul style="list-style-type: none"> Work left to right Use order of operations Place numbers on one side, variables on the other side
<i>Obtain squares and square roots.</i>	<p>Review the methods for calculating squares, square roots, cubes, and cube roots. Use industry-related formulas to demonstrate examples.</p> <p>Compare the difference between the 2 common answers to 3^2 (answer = 9, not 6).</p>

	How would an incorrect value affect the work on the job?
Convert units of measure: <i>Recognize components of measuring systems (US and metric) for length.</i>	Discuss industry measures and terms relating to length.
Convert units of measure: <i>Recognize components of measuring systems (US and metric) for mass/weight.</i>	Discuss industry measures and terms relating to mass/weight.
Convert units of measure: <i>Recognize components of measuring systems (US and metric) for volume.</i>	Discuss industry measures and terms relating to volume.
<i>Measure with a certain degree of accuracy.</i>	<p>Estimate measurements.</p> <p>Using workplace materials* and tools, take measurements of work-related and classroom items.</p> <p>Depending on ability level, students may measure to the nearest foot, inch, centimeter, etc.</p>
APPLICATIONS	
<i>Solve word problems.</i>	Help students feel more comfortable with word problems by placing simpler problems in word problem form; or take concepts students have already mastered and ask them to write word problems for each other to solve.
<i>Select/apply mathematical formula.</i>	Review a set of math formulas and then a list of sample problems. Decide which formula(s) apply to each problem.
<i>Understand the importance of time in the workplace.</i>	Using workplace materials*, make a list of workplace scenarios that require using time correctly, such as keeping a time card, or heating a liquid solution for 20 minutes.
<i>Recognize components of time systems (clocks and calendars).</i>	<p>AM and PM</p> <p>Leap Year</p> <p>Military time</p>

<p><i>Discuss, Identify, Understand</i> terms relating to measuring time.</p>	<p>Discuss the units of time measurement and time vocabulary: second, minute, hour, day, week, month, year, leap year, fiscal year, quarter, annual, biannual, etc.</p>
<p><i>Understand</i> that time can be expressed in terms of equivalencies.</p>	<p>Show the time equivalencies using fractions. For example: $1 \frac{1}{2} \text{ days} = \underline{\hspace{1cm}} \text{ hours}$</p> $\begin{array}{rcl} 1 \text{ day} & = & 24 \text{ hours} \\ + \frac{1}{2} \text{ day} & = & \underline{+12 \text{ hours}} \\ 1 \frac{1}{2} \text{ days} & = & 36 \text{ hours} \end{array}$
<p><i>Compute</i> time conversions.</p>	<p>Make a table that shows the equivalencies of time units.</p> <p>Compute conversion problems at the appropriate level of difficulty. Examples include:</p> <ul style="list-style-type: none"> • Convert minutes to hours • Convert hours to days • Convert seconds to years.
<p><i>Calculate</i> ratio and proportion.</p>	<p>Review fractions when discussing ratio and proportion.</p> <p>Draw common classroom items to scale by finding a conversion rate (1 foot equals 1 inch).</p> <p>Make predictions using ratios. (If each student in class has 3 children, how many children will there be all together? Write the ratios.)</p>
<p><i>Apply</i> geometry principles: Use formulas for measuring shapes of 2 dimensions.</p>	<p>Determine the formulas that apply to 2 dimensions: perimeter, area, surface area, etc.</p> <p>Find perimeter of classroom. Discuss perimeter of objects that are not shaped as perfect squares. How does this change the formula for perimeter?</p> <p>Find the area of the tiles on the floor. Find the area of the classroom.</p>

	Review that all areas are expressed in terms of square units (square inches, square miles, etc)
<i>Apply geometry principles: Use formulas for measuring shapes of 3 dimensions.</i>	Review the formulas that apply to 3 dimensions of objects: volume. Find the volume of common objects such as soda cans, pizza boxes, etc. Review that volume is expressed in cubic units. Discuss industry-specific needs for these formulas; for example, find the volume of a tank or silo.
<i>Define terms relating to money.</i>	Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles relating to money. For more advanced students, include terms and principles of economics, finance, or statistics.
<i>Perform one-step problems involving money.</i>	Make change. Count up (rather than backwards) to make change.
<i>Perform multiple-step problems using money.</i>	Calculate gross and net earnings. Calculate <ul style="list-style-type: none"> ▪ Interest ▪ Sales tax ▪ Percent off ▪ Sale price ▪ Profit percentages Perform banking transactions.
<i>Perform business-related financial activities.</i>	At a level of complexity appropriate to your industry and to students' ability levels, solve income/expense problems, prepare budgets, etc.
<i>Use a calculator to perform computations.</i>	Identify appropriate activities that can be performed using a calculator (calculators

	<p>allow students to concentrate on problem-solving strategies.</p> <p>Award prizes for weekly activities or competitions.</p>
<i>Calculate measurements taken from measuring devices.</i>	Add, subtract, multiply and divide measurement numbers by plugging them into formulas.
<i>Perform/prepare an inventory.</i>	<p>Use a sample group of items to prepare an inventory.</p> <p>Review inventory vocabulary terms.</p> <p>Discuss the math processes that would apply to the inventory process.</p>
DATA ANALYSIS AND DISPLAY	
<i>Recognize types of visual representations.</i>	<p>Charts</p> <p>Graphs</p> <p>Tables</p>
<i>Interpret charts, graphs and tables.</i>	<p>Answer simple questions about charts, graphs and tables.</p> <p><i>Solve</i> multi-step problems involving the correlation of graphs and tables.</p>
<i>Collect/record data.</i>	<p>As appropriate to industry, practice sampling methods. Discuss safety precautions for sampling. Visit OSHA at the Department of Labor website for more details.</p> <p>Practice collecting and recording sample data from your industry (such as measurements taken using a micrometer). Compare class answers.</p> <p>Find the range of answers (maximum and minimum). Find the average.</p> <p>Discuss an acceptable range of answers (\pm), and graph the results showing the number that fell inside and outside the acceptable range.</p>

<i>Review and apply principles of probability.</i>	Use real-life examples that are highly motivating to direct the students' attention to probability principles. (Example, "I am thinking of a number between 1 and 50. The person who guesses the number will receive that many bonus points if she can tell me the probability of choosing the number correctly.")
Use probability models to predict chance events.	Calculate <u>theoretical probability</u> of an event (e.g., the probability of rolling a 5 on a die is $1/6$). Find <u>empirical probability</u> of an event by performing repeated experiments. Compare the 2 probabilities.
<i>Calculate and interpret statistics.</i>	Identify the importance of using statistics correctly. Bring examples of statistics from the news or media and analyze them: are they ambiguous? Are they correct? What data is the advertisement trying to get the public to see? For a humorous look at statistics, see <i>How to Lie with Statistics</i> by Huff and Geis.
<i>Interpret plans/blueprints.</i>	Review vocabulary and terms for plans, blueprints and schematics. Build a plan or blueprint one layer at a time, starting with the basic identifying information. Add layers of wax paper or other transparent drawing material on top of the first layer that allows each layer to be viewed individually, or the entire drawing as a whole.
<i>Construct charts and tables.</i>	Discuss chart types and chart vocabulary. Using workplace or sample data from the class, construct tables and charts.

	<p>For a daily example, consult <i>USA Today</i> online and look for the snapshots section that shows a graph of some sort. Ask weekly bonus questions about the data.</p> <p>Challenge students to bring in examples of charts and graphs containing errors.</p>
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ACADEMIC STANDARDS FOR SCIENCE

Strategies for Reinforcement in the Vocational-Technical Classroom

Note:

*** indicates industry-related materials, handouts, notes, etc.**

Topics Listing

General Science- topics not specific to a content area

Physical Science-

- Mechanics and Physics
- Energy and Waves
- Thermodynamics
- Electromagnetism
- Chemistry
- Optics

Life Science-

- Cell biology
- Evolution
- Genetics and Heredity
- Human and Animal Development

Anatomy

- Ecology
- Viruses
- Bacteria
- Plants

Earth Science-

- Earth in space
- Solar System/Astronomy
- Atmosphere and weather
- Oceans and water
- Earth resources

Note:

* indicates industry-related materials, handouts, notes, etc.

Objective	Classroom Applications to Industry
GENERAL SCIENCE	
<p><i>Present,</i> <i>Review and Discuss,</i> Master the list of skills employers want for the workplace regarding science skills.</p>	<p>Use the list of skills employers want to introduce students to the requirements of the workplace.</p> <p>Depending on students' ability levels, any of the following methods may be used to increase their understanding of the concepts:</p> <ul style="list-style-type: none"> • Discussion • Interviewing parents or other adults in the workplace about the skills required • Interviewing employers about the skills in terms of importance • Identifying workplace situations in which certain skills become more important than others • Researching adult education programs to learn why deficits in these areas must be remediated; find out the cost to employers to educate adult workers • Researching the topic of adult literacy
<p><i>Perform</i> computations as required to solve problems.</p>	<p>Use the metric system to convert units of measure.</p> <p>Round numbers to correct number of significant figures.</p> <p>Determine percentage of error.</p> <p>Understand validity, reliability, accuracy, and precision.</p>
<p><i>Apply</i> scientific method of inquiry.</p>	<p>Identify the steps of the scientific method.</p> <p>Conduct experiments.</p> <p>Understand the following terminology: Conclusions vs inferences Variables Replications Samples/sample size</p>

<i>Investigate science history as it applies to industry.</i>	<p>In groups, research topics in science pertaining to your industry. Have students assign roles for each member of the group.</p> <p>Present findings in report format, or in oral presentations.</p> <p>Investigate science ethics.</p> <p>Recognize the processes available for accountability in industry. For example, OSHA has a Safety and Health Program Assessment Worksheet whereby employers can be rated for safety issues. See http://www.osha.gov/SLTC/safetyhealth_ecat/mo d3.htm</p> <p>[Note: Safety and Health is a mandatory subject of bargaining when a workplace is unionized; in both unionized and non-unionized workplaces, an employer cannot create and dominate workplace safety committees (see the National Labor Relations Act).]</p>
<i>Use scientific instruments to measure aspects of the environment.</i>	Gather data on time, length, mass, pressure, volume, acceleration or other measureables using instruments from the job.
<i>Demonstrate an understanding of data.</i>	<p>List the processes involved in gathering data.</p> <p>Suggest ways that data can be grouped or organized.</p> <p>Collect specimens.</p> <p>Show how data can be represented (graphically, charts and diagrams, etc)</p> <p>Construct a model to depict a basic concept.</p>
<i>Identify the seven basic S I (Systeme International) units.</i>	<p>Length- meter- m</p> <p>Mass- kilogram- kg</p> <p>Time- second- s</p> <p>Electric current- ampere- A</p>

	<p>Temperature- Kelvin- K Amount of substance- mole- mol Luminous intensity- candela- cd</p> <p>Dictionary of units- see http://www.ex.ac.uk/cimt/dictunit/dictunit.htm</p>
<i>Identify S I (Systeme International) Derived units.</i>	<p>Choose units appropriate to your industry (hertz, ohm, volt, watt, etc).</p> <p>Create a picture dictionary demonstrating the concepts.</p>
<i>Review relevant theories, laws and models.</i>	As relating to your industry, discuss important theories, laws and models.
<i>Use reference tools to solve problems.</i>	Use scientific reference tools (such as the Periodic Table of Elements) to learn more about specific industry concepts.
<i>Practice safe lab procedures.</i>	<p>Handle equipment with care.</p> <p>Demonstrate safety and first aid procedures.</p> <p>Identify harmful substances.</p>
PHYSICAL SCIENCE	
<i>Understand the cyclical nature of systems.</i>	<p>Show, demonstrate, model, track the cycles of any of the following systems:</p> <p>Growth and decay Food webs Weather Water</p>
<i>Analyze/classify matter according to type.</i>	<p>Identify types of matter (solids, liquids, gases). Which types are predominantly used in your area of industry?</p>
<i>Explain the concepts of work and power.</i>	<p>Identify machines used in industry.</p> <p>Identify how energy levels change when work or power is increased/decreased.</p> <p>Identify fuel sources used in your industry.</p> <p>Discuss internal and external combustion.</p>

	Create a model demonstrating the uses of levers and pulleys.
<i>Be familiar with concepts of motion.</i>	<p>Measure acceleration and deceleration</p> <p>Understand the relationship between speed and velocity by performing experiments.</p> <p>Recognize waves and vibrations as a type of motion.</p> <p>Understand action and reaction.</p> <p>Review laws pertaining to motion.</p>
<i>Understand concepts related to force.</i>	<p>Show the need for balance of forces acting on an object.</p> <p>Observe centrifugal and centripetal forces in action.</p> <p>Show how friction is created and must be accounted for in using and preserving equipment.</p> <p>Create a chart showing types of lubricants needed in a factory and schedule of maintenance.</p> <p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of inertia.</p> <p>Show the relationship between pressure, mass, and weight.</p>
<i>Understand and apply principles relating to the atom.</i>	<p>Understand that atoms have a positive, negative or neutral charge. (Classify protons, electrons, and neutrons.)</p> <p>Identify ions.</p>
<i>Investigate forms of and changes in energy.</i>	<p>Discuss how energy is measured.</p> <p>Observe changes in energy relationships.</p> <p>Identify catalysts and reactants.</p>

	Identify sources of kinetic and potential energy in your industry.
<i>Discuss, apply principles of electricity and electric currents.</i>	<p>Identify types of circuits and switches.</p> <p>Show the difference between direct and alternating currents. Give examples of the best/most efficient use of each.</p> <p>Determine how electricity is measured, and solve problems using these terms. (Example, use Ohm's law to calculate current, resistance, and voltage.)</p> <p>Identify good conductors and insulators, and how to choose them.</p> <p>Understand grounding and create a visual display of grounding safety practices. Include the threat of static electricity.</p> <p>Show the uses of a vacuum tube by building a model.</p> <p>Compare the following ways of generating electricity: Hydroelectricity Motors Solar Power Steam/nuclear Transformers Incandescent (Light) Show the implications for your industry.</p> <p>As appropriate to your industry, identify electrochemical energy sources (cells, electrodes, batteries) and the processes of oxidation and reduction.</p>
<i>Be familiar with sound waves.</i>	<p>Compare how sound waves travel between liquids, solids, and air.</p> <p>Examine different types (lengths) of sound waves. Examine decibels safe for human hearing. Identify safety precautions for industry regarding sound tolerance.</p>

	<p>Be able to use correctly the terms below as they relate to your industry. (For example, ask students to write a short essay explaining a demonstration from class and include the following terms):</p> <p>Amplification Audible range Frequency Acoustics Resonance Speed</p>
<i>Be familiar with principles of heat.</i>	<p>Differentiate between the 3 types of heat transfer (conduction, convection, radiation).</p> <p>Understand that substances expand and contract due to heating and cooling</p> <p>Identify purpose and types of insulations used.</p> <p>Differentiate between heat and temperature.</p>
<i>Investigate and apply concepts relating to temperature.</i>	<p>Use the temperature scales; convert between Celsius and Fahrenheit.</p>
<i>Explain the concepts of magnetism.</i>	<p>Understand that currents create magnetic fields.</p> <p>Identify materials that are good conductors, and the properties that make them such.</p> <p>Understand electromagnetic forces present in earth.</p>
<i>Investigate/apply chemical properties.</i>	<p>Differentiate between acids and bases. Find pH for substances used in industry.</p> <p>Identify substances used in your industry and classify them by type.</p> <p>Name the major drugs, fertilizers, or additives used in your industry. Define and state examples of chemical reactions.</p> <p>Be familiar with solutions used in your industry. Compare saturated and unsaturated solutions. Determine whether a solution is soluble or insoluble.</p>

	Explain solute and solvent.
<i>Investigate forms of and changes in matter.</i>	<p>Compare and contrast physical and chemical changes.</p> <p>Discuss the types of physical or chemical changes that take place in your industry, from processing raw materials to manufacturing.</p>
<i>Understand and apply concepts relating to the elements.</i>	<p>Examine the 4 elements that make up 99% of living organisms (Hydrogen (H), Oxygen (O), Nitrogen (N), and Carbon (C)).</p> <p>Element Groups:</p> <ul style="list-style-type: none"> Alkali Metals Alkaline Earth Metals Transition Metals Other Metals Metalloids Non-Metals Halogens Noble Gases Rare Earth Elements
<i>Be familiar with principles of light.</i>	<p>Discuss light as a form of energy.</p> <p>Describe types of lighting systems.</p> <p>Examine the light spectrum and note the relative smallness of visible light.</p> <p>Define reflection and refraction.</p> <p>Explain how light carries information (by lasers) and show examples of the impact on technology/industry.</p> <p>Identify types of lenses.</p>
<i>Be familiar with principles of color.</i>	<p>Diagram the main parts of the eye involved in seeing color (rods, cones).</p> <p>Use prisms to split light into the visible spectrum. Briefly explore color blindness. What precautions should colorblind persons take regarding workplace safety?</p>

	Define situations in which colorblindness impacts a worker's ability to do his job.
LIFE SCIENCE	
<i>Explain the presence of cells as the identifier of all living organisms.</i>	<p>Examine the cells of organic material used in your industry, using books, the internet, or a microscope.</p> <p>Recognize that cells divide or replicate to promote growth of an organism.</p> <p>Examine the parts of a cell. Compare the cell to a machine...how do the parts function and rely on each other?</p> <p>Give example of one-celled and multiple-celled organisms.</p> <p>Review the classification system of all organisms (Kingdom, Phylum, etc).</p> <p>Create a circle graph or pie chart (totaling 100%) showing the relationship (in numbers) between the groups of organisms: Bacteria Fungi Viruses Insects Plants Vertebrates Invertebrates</p> <p>Compare some of the cell processes (active and passive transport) to the processes in your industry.</p>
<i>Understand the progress of evolution of organisms.</i>	Recognize how a species will adapt to better fit in its environment over time.
<i>Explain the role of genetics in human development.</i>	<p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of heredity, including:</p> <ul style="list-style-type: none"> • Half of an individual's genes are contributed by each parent • Traits that are inherited are either dominant or recessive from the parent(s)

	<ul style="list-style-type: none"> • Cell division by mitosis versus meiosis • Disabilities are caused either by genetic/inherited conditions (such as Down's Syndrome) or in accidents occurring after birth, such as brain damage due to a car accident or a stroke
<i>Investigate/apply principles of human development.</i>	<p>Describe the life cycle of humans and other animals.</p> <p>Use the concept of human development to explain the need for understanding foundation skills in your area. (For example, children do not run before they walk.) Use this concept to explain other events that occur in a natural order in your industry.</p>
<i>Explore additional concepts pertaining to humans and other animals.</i>	<p>Give examples of ways organisms adapt to their environment.</p> <p>As relating to industry, review the concepts of:</p> <p>Aging Immune system Skin and Tissues Blood and hemoglobin Disease</p>
<i>Compare/contrast the differences between sexual and asexual reproduction.</i>	<p>Determine instances when understanding the concepts of sexual reproduction are important for your industry.</p> <p>Highlight the effects of unsafe working practices on unborn fetuses, or the dangers present for pregnant individuals working in industry.</p>
<i>Show a general understanding of the importance of health.</i>	<p>Explore the cost of lost wages and worker's compensation in the past year due to health problems.</p> <p>Research the most common health problems among workers (workers with safe jobs; workers with most hazards to health, etc)</p>
<i>Investigate the food cycle.</i>	<p>Identify food chains, food webs, food pyramids.</p> <p>Show how changes to the food cycle affect the</p>

	<p>environment and affect man.</p> <p>Name the food groups.</p>
<i>Understand</i> nutrition and the body's need for a diet that provides vitamins and minerals.	<p>Show an understanding of body systems (circulatory, nervous, digestive, etc) as they relate to industry.</p> <p>Identify deficient vitamins and minerals among a particular population (American workers, workers in specific environments, workers who do not go outdoors, or who always work outdoors) and the health risks associated with job types (office work, mining work, etc.)</p>
<i>Observe</i> health code/sanitation requirements.	<p>Research the development of health code and sanitation requirements, including OSHA.</p> <p>Compare/contrast workplaces of 1850, 1900, 1950, 2000 regarding health and safety.</p> <p>Discuss the most common workplace violations of health requirements and present in a graphic format (e.g., maps, charts).</p> <p>Discuss potential effects of ignoring health requirements.</p> <p>After identifying workplace hazards, create several plans to treat the problem. Debate the benefits of each.</p> <p>To avoid the threat of employers choosing ineffective means of ensuring safety on the job, locate MSDS sheets, first aid stations, personal protective equipment, worker's compensation claims offices/paperwork, etc.</p> <p>Using workplace materials*, locate the section on safety regulations. Ask students to rank order the items. Debate the importance of each. Determine the threat of ignoring regulations. Research which regulations are often disregarded.</p> <p>Explore proactive measures students can take to extend their health.</p> <p>Understand the importance of mental health in</p>

	addition to physical health.
<i>Investigate/apply</i> principles of anatomy and physiology.	<p>As relating to your industry, explore issues relating to anatomy and physiology.</p> <p>Skeletal system- study the bones of the arm, hand, and neck. Research carpal-tunnel syndrome.</p> <p>Fractures- identify the types of fractures and those most common to your line of work. Learn how to prevent falls.</p>
<i>Understand</i> basic principles of Ecology.	<p>Define ecology.</p> <p>Identify 5 major ways in which man interacts with the environment, especially as relating to your industry.</p> <p>Discuss the effectiveness of the media as compared to pro-science groups (such as Greenpeace) on the public's awareness of important environmental issues.</p> <p>Identify any areas of concern regarding waste/waste management in your industry.</p> <p>Show the difference between a niche, community, habitat, and ecosystem.</p> <p>Give examples of herbivores, carnivores, and omnivores. How does your industry use and serve each group?</p> <p>Understand predators' effects on food chains. Identify predators of industry.</p> <p>Explain the process of decomposition and decay. How does industry interfere with or interrupt these processes?</p>
<i>State</i> the differences between viruses and bacteria.	<p>Define viruses and bacteria.</p> <p>Explore viral and bacterial threats present in the workplace. How can they be prevented? How can they be treated?</p> <p>State the benefits of viruses and bacteria.</p>

	Explain the recent increased resistance to drugs and antibiotics.
<i>Understand</i> basic concepts relating to plants.	<p>Describe the interchange of oxygen and carbon dioxide between plants. Contrast to the way humans exchange oxygen and carbon dioxide.</p> <p>As relating to industry, review the concepts of: Fertilization Parts of plant, and functions of each Effects of temperature on plants Need for water and light Photosynthesis</p>
EARTH SCIENCE	
<i>Recognize</i> earth's position in the universe.	<p>As relating to your industry, identify relevant topics regarding Asteroids Comets Stars Galaxies</p> <p>Identify planets in the solar system.</p> <p>Compare and contrast earth to other planets.</p> <p>Create a model showing the relative size of earth within our solar system. Use mathematical relationships to make sure the scale is correct (earth is the size of ____ so the sun should be the size of ____).</p> <p>How do the phases of the moon and sun affect the hemispheres?</p>
Investigate history of the earth.	<p>Identify geological, chemical and other methods of determining the age of an object.</p> <p>Demonstrate that fossils and rocks are indicators of previous eras.</p> <p>As a class, create a timeline indicating the age of the earth. Include the various ages (Ice Age, etc) and the length of each.</p> <p>Make sure the timeline is drawn to scale.</p>

	<p>Assign each Age to a group and research the following:</p> <p>Weather</p> <p>Major events at beginning and end of age</p> <p>Organisms living during this time</p> <p>Factors that made the Age unique</p>
<i>Investigate</i> physical characteristics of the earth.	<p>Label/model the components of the earth.</p> <p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of gravity.</p> <p>Solve problems of longitude, latitude and time zones.</p> <p>Create a model of the ratio of land and water on earth.</p>
<i>Investigate</i> physical forces acting on the earth.	<p>Examine erosion and depletion of nonrenewable resources.</p> <p>Identify natural disasters such as hurricanes and earthquakes. Research the effects of a past disaster on a specific industry.</p> <p>Understand, at a level of complexity appropriate to your industry and to students' ability levels, basic principles of plate tectonics (the earth's surface is broken into large plates; movements of these plates over time causes earthquakes and other geologic activity).</p>
<i>Explain</i> the basic components of earth's rotation.	<p>Understand that the earth spins on its axis at an angle of 23 ½ degrees</p> <p>Identify the period of one complete rotation as a day; longer cycles of rotations identify the seasons.</p> <p>Discuss time zones.</p>
<i>Identify</i> the earth's atmosphere and its components.	<p>Identify the main elements in the earth's atmosphere (nitrogen and oxygen).</p> <p>Identify layers of the atmosphere, and the ozone layer.</p>

	Explain concepts of air pressure.
<i>Understand</i> basic principles of the solar system.	Demonstrate how the sun strikes the earth at different angles depending on location.
<i>Demonstrate</i> the relationship between climate and weather.	<p>Identify the factors that create weather.</p> <p>Show how landscape features are affected by changes in climate or weather.</p> <p>Identify the greenhouse effect. How does industry contribute to it?</p> <p>Describe the relationship between altitude and weather.</p> <p>Understand that changes in the weather may be seen as fronts that are put in motion by the jet stream.</p> <p>Identify types of precipitation.</p> <p>Differentiate between types of clouds.</p> <p>Understand the effect of winds, wind speeds, and impacts on vegetation.</p>
<i>Learn and apply</i> concepts relating to the oceans.	<p>Label the major oceans and seas.</p> <p>Determine the elements in ocean water (nearly all elements are present).</p> <p>Identify or draw the structural components of the ocean floor.</p> <p>Explain the relationship between the moon and the tides.</p> <p>Explore ways the ocean is used for power and business.</p>
<i>Investigate</i> principles of water.	<p>Identify the parts of the water cycle and the effects of the processes involved.</p> <p>Define water's chemical properties water is the universal solvent water has a neutral ph of 7</p>

	<p>chemically, water is one atom of oxygen bound to two atoms of hydrogen)</p> <p>Measure salinity. Which industries rely heavily on water?</p> <p>Define water's physical properties water is the only natural substance that exists as solid, liquid, and gas water's surface has a high density water has a high tolerance for heat (heat index) water's weight water as a coolant specific gravity</p>
<i>Investigate conservation of physical and natural resources.</i>	<p>As relating to your industry, discuss or debate the issues of Allocation of resources Recovering resources Best/worst methods of using resources</p> <p>Compare/contrast renewable and nonrenewable resources.</p> <p>Note the important developments in your industry regarding mineral, soil, water, and wildlife conservation.</p> <p>Discuss alternative sources of energy as relating to your industry.</p>
<i>Investigate issues regarding scientific technology.</i>	<p>As relating to your industry, discuss the uses of technology. What are the newest developments?</p> <p>What effects does the technology have on our society? Political system?</p> <p>Discuss the role of economics on technology.</p>
<i>Apply science principles/laws to environmental issues.</i>	<p>Discuss how mankind alters the earth and environment through use of resources and technology, pollution.</p>

Crosswalk to SkillsUSA Welding

SkillsUSA, the co-curricular student organization for Trade and Industrial Education, provides many opportunities through its program of work for students to apply the knowledge, skills, and processes learned in a variety of courses. A correlation of the Welding technical contest to selected tasks/competencies in Arkansas's Welding courses is provided as a supplement to this framework.

Purpose

To evaluate each contestant's preparation for employment and to recognize outstanding students for excellence and professionalism in the field of welding.

Clothing Requirement

Official SkillsUSA khaki work shirt and pants, black or brown leatherwork shoes, and safety glasses with side shields or goggles. (Prescription glasses can be used only if they are equipped with side shields. If not, they must be covered with goggles.) To purchase official work clothes, contact Midwest Trophy Manufacturing Co. Inc. by calling 1-800-324-5996 or order online at: <http://www.mwtrophy.com/vica/index.html>.

Eligibility

Open to active SkillsUSA members enrolled in programs with welding as the occupational objective.

Equipment and Materials

- Supplied by the technical committee:
 - All necessary welding equipment and materials
 - All instructions and procedure sheets with drawings
 - All necessary information and furnishings for judges and the technical committee
- Supplied by the contestant:
 - Hearing and/or ear protection

- Welding helmet with appropriate filter plate/lens and protective cover plate/lens in a flip or slide front. Auto darkening shields are permissible.
- Welding helmet with appropriate filter plate/lens and protective cover plate/lens in a flip or slide front for OFC, PAC. Auto darkening shields are permissible.
- Spare spatter and filter lenses/plates for arc welding helmet and oxyacetylene goggles
- Pocket calculator
- Lead pencil and/or ballpoint pen
- Soapstone with holder
- Scribe with magnet
- Combination square set
- 0-foot (3.1 meters) steel tape measure
- Fillet weld gauge
- 16-ounce (.45 kilogram) ball peen hammer
- Center punch
- 10-inch (254 millimeters) vise grips
- 6-inch (152 millimeters) side cutting pliers or diagonal cutting pliers
- 6-inch (152 millimeters) needle nose pliers
- Chipping hammer with or without wire brush
- Stainless steel wire brush

Specific Rules for Contest Participants

- Contestants must correctly use the welding equipment during the contest. The contest chairman and contest coordinator may stop a contestant at any section of the contest if they deem a contestant's manner to be hazardous to either themselves or others. Such stoppage shall disqualify the participant for that section of the contest. If the contestant is warned a second time, he or she will be disqualified as a contest participant.
- Contestants will be assigned a contest number for use during the welding contest. The contest judges will know the contestants by their assigned number only.

- While the contest is in progress, there shall be no communication between the contestants or between the contestants and anyone else, except as directed by a judge, contest coordinator or contest chair.
- The welding contest will be of a performance nature.
- All terms and definitions and welding symbols will be in accordance with the current editions of ANSI/AWS A3.0 (Terms & Definitions) and ANSI/AWS A2.4 (Symbols).
- Time limits will be established on the contest procedure sheets for all segments of the test.
- Evaluation of the completed project will be judged visually. Nondestructive and/or destructive tests may be used to complete the project evaluation.
- Welding and cutting operation instructions will be specified in drawings and procedure sheets provided to the contestants.

Scope of the Contest

Contestants will demonstrate their ability to perform jobs and skills selected from the following list of competencies as determined by the SkillsUSA Championships technical committee. Committee membership includes: Alabama Power, American Welding Society, ARCET, Arcsmith, Daimler Chrysler Corp., Emmert Welding and Manufacturing Co., ESAB Welding & Cutting Products, Hobart Institute of Welding Technology, Lincoln Electric Co., Honeywell Engines & Systems, Honeywell Aero-space Services, Linweld, Miller Electric Manufacturing Co., NS Hillyard AVTS (Missouri), Ohio State University and Welding Education and Consulting..276 *SkillsUSA Championships Technical Standards (2002–2004)*

- *Weld a butt joint with a single-pass, square groove weld on carbon steel and stainless steel sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
- *Weld a butt joint with a single-pass, V-groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down and overhead positions.
- *Weld a butt joint with a partial joint penetration, single pass, double V-groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down and overhead positions.

- Weld a butt joint with a multiple pass, V-groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down and overhead positions.
- Weld a butt joint with complete joint penetration, multiple pass, double groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down and overhead positions.
- Weld 6-inch (150 millimeter) or 8-inch (200 millimeter) diameter and smaller, schedule 40, carbon steel and stainless steel pipe, single/multiple pass V-groove weld in the 2G, 5G and 6G positions.
- Lay out, weld, cut and prepare coupons for evaluation.
- Test prepared coupon.
- Gas Metal Arc Welding (GMAW)
 - *Demonstrate correct safety procedures for GMAW.
 - Demonstrate ability to correctly set up GMAW power sources, related welding equipment and do basic process and equipment troubleshooting.
 - Correctly identify base metal prior to welding.
 - *Set up and shut down equipment for short circuiting, globular, spray and pulsed transfer welding of carbon steel, stainless steel and/or aluminum.
 - Select correct type of filler metal size of electrode, type of shielding gas, wire feed speed and voltage based on carbon steel, stainless steel and/or aluminum sheet and/or plate (1 /16 -inch to 3 /8 –inch thickness).
 - *Prepare the carbon steel, stainless steel and/or aluminum for welding.
 - Start, stop and restart stringer beads on carbon steel, stainless steel and aluminum steel sheet/plate in the flat, horizontal, vertical up and down, and overhead positions.
 - Weld a pad with a multiple-pass weld on carbon steel, stainless steel and aluminum sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
 - *Weld a lap joint with a single-pass, fillet weld on carbon steel, stainless steel and aluminum sheet/plate in flat, horizontal, vertical up and down and overhead positions.

- Weld a lap joint with a multiple-pass, fillet weld on carbon steel, stainless steel and aluminum plate in the flat, horizontal, vertical up and down and overhead positions. Interrupt root pass at mid point and restart arc.
 - *Weld a T-joint with a single-pass, fillet weld on carbon steel, stainless steel and aluminum sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
 - Weld a T-joint with a multiple-pass, fillet weld on carbon steel, stainless steel and aluminum plate in the flat, horizontal, vertical up and down and overhead positions.
 - Note: The following items marked * should be considered essential.
- **Safety**
 - *Demonstrate personal safety.
 - *Demonstrate general shop safety.
 - *Demonstrate gas, electrical and chemical safety.
 - *Demonstrate knowledge of proper actions to be taken in an emergency.
 - **Measurements**
 - Identify basic metalworking tools used in measuring.
 - *Use visual measuring tools to accuracy of 1 /32 of an inch.
 - Employ the components of a combination square set.
 - *Use layout and marking tools as required.
 - *Determine wire feed speed as indicated on drawing.
 - **Blueprint Reading**
 - *Use information found in the information block of the drawing.
 - *Read and understand three-dimensional drawings.
 - Identify the basic views used in blueprints including assembly, detail and fit-up drawings.
 - *Identify common types of lines, abbreviations and symbols in accordance with national drawing standards—ANSI.

- *Identify basic welding symbols and components of a symbol (such as arrow, reference line, tail, size or length) in accordance with the national welding symbols standards—AWS.
 - Shielded Metal Arc Welding (SMAW)
 - *Demonstrate safety procedures for SMAW.
 - *Demonstrate ability to correctly set up SMAW power sources, related welding equipment and do basic process and equipment troubleshooting.
 - Correctly identify base metal prior to welding.
 - *Set up and shut down equipment for welding of carbon steel and/or stainless steel.
 - Select correct type of filler metal size of electrode based on carbon steel and/or stainless steel plate (1 /4 -inch to 1 /2 -inch thickness).
 - *Prepare carbon steel and/or stainless steel for welding.
 - *Start, stop and restart stringer beads on carbon steel and/or stainless steel in the flat, horizontal, vertical up and down and overhead positions.
 - *Weld a pad with a multiple pass weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down and overhead positions.
 - *Weld a lap joint with a single pass, fillet weld on carbon steel and stainless steel sheet/plate in flat, horizontal, vertical up and down and overhead positions.
 - Weld a lap joint with a multiple pass, fillet weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down and overhead positions.
 - *Weld a T-joint with a single-pass, fillet weld on carbon steel and stainless steel sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
 - Weld a T-joint with a multiple-pass, fillet weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and down and overhead positions.
- Sponsored by Goodheart-Willcox Publisher 277*
- *Weld a butt joint with a single-pass, square groove weld on carbon steel, stainless steel and aluminum sheet/plate in the flat, horizontal, vertical up and down and overhead positions.

- *Weld a butt joint with a single-pass, V-groove weld on carbon steel and stainless steel and aluminum plate in the flat, horizontal, vertical up and down and overhead positions.
- *Weld a butt joint with a partial joint penetration, single-pass, double V-groove weld on carbon steel, stainless steel and aluminum plate in the flat, horizontal, vertical up and down and overhead positions.
- Weld a butt joint with a multiple-pass, V-groove weld on carbon steel, stainless steel and aluminum plate in the flat, horizontal, vertical up and down and overhead positions.
- Weld a butt joint with complete joint penetration, multiple-pass, double V-groove weld on carbon steel, stainless steel and aluminum plate in the flat, horizontal, vertical up and down and overhead positions.
- Weld 6-inch (150 millimeter) or 8-inch (200 millimeter) diameter and smaller, schedule 40, carbon steel, stainless steel and aluminum pipe, single/multiple pass V-groove weld in the 2G, 5G and 6G positions.
- *Lay out, weld, cut and prepare coupons for evaluation.
- Test prepared coupons.
- Fluxed Cored Arc Welding (FCAW)
 - *Demonstrate correct safety procedures for FCAW.
 - *Demonstrate ability to correctly set up FCAW power sources, related welding equipment and do basic process and equipment troubleshooting.
 - Correctly identify base metal prior to welding.
 - *Set up and shut down equipment for welding of carbon steel and/or stainless steel.
 - Select correct type of filler metal, size of electrode, type of shielding gas (if needed), wires feed speed and voltage based upon carbon steel and/or stainless steel sheet and/or plate (1 /16 -inch to 3 /8 –inch thickness).
 - *Prepare carbon steel and/or stainless steel for welding.
 - *Start and stop and restart stringer beads on carbon steel and stainless steel sheet/plate in the flat, horizontal, vertical up and overhead positions.

- Weld a pad with a multiple-pass weld on carbon steel and stainless steel sheet/plate in the flat, horizontal, vertical up and overhead positions.
- *Weld a lap joint with a single-pass, fillet weld on carbon steel and stainless steel sheet/plate in flat, horizontal, vertical up and overhead positions.
- Weld a lap joint with a multiple-pass, fillet weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and overhead positions. Stop and restart in middle of joint.
- *Weld a T-joint with a single-pass, fillet weld on carbon steel and stainless steel sheet/plate in the flat, horizontal, vertical up and overhead positions.
- Weld a T-joint with a multiple-pass, fillet weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and overhead positions.
- *Weld a butt joint with a single-pass, square groove weld on carbon steel and stainless steel sheet/plate in the flat, horizontal, vertical up and overhead positions.
- *Weld a butt joint with a single-pass, V-groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up positions.
- *Weld a butt joint with a partial joint penetration, single pass, double V-groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and overhead positions.
- Weld a butt joint with a multiple-pass, V-groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and overhead positions.
- Weld a butt joint with complete joint penetration, multiple-pass, double V-groove weld on carbon steel and stainless steel plate in the flat, horizontal, vertical up and overhead positions.
- Weld 6-inch (150 millimeter) or 8-inch (200 millimeter) diameter and smaller, schedule 40, carbon steel and stainless steel pipe, single/ multiple pass V-groove weld in the 2G, 5G and 6G positions.
- *Lay out, cut and prepare coupons for evaluation.
- Test prepared coupons.
- Gas Tungsten Arc Welding (GTAW)
 - *Demonstrate safety procedures for GTAW.

- *Demonstrate ability to correctly set up GTAW power sources, related welding equipment and do basic process and equipment troubleshooting.
- Correctly identify base metal prior to welding.
- *Set up and shut down equipment for regular and pulsed welding of aluminum, stainless steel and/or carbon steel.
- *Select the correct size and type of tungsten and/or filler metal based on aluminum, stainless steel or carbon steel sheet and/or plate (1 /16 -inch to 1 /4 – inch thickness).
- *Prepare aluminum, stainless steel and/or carbon steel for welding.
- *Start, stop and restart stringer beads on aluminum, stainless steel and carbon steel sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
- Weld a pad with multiple-pass weld on aluminum, stainless steel and carbon steel sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
- *Weld a lap joint with a single-pass, fillet weld on aluminum, steel, stainless steel and carbon steel sheet/plate in flat, horizontal, vertical up and down and overhead positions.
- Weld a lap joint with a multiple-pass, fillet weld on aluminum, stainless steel and carbon steel plate in the flat, horizontal vertical up and down and overhead positions.
- *Weld a T-joint with a single-pass fillet weld on aluminum, stainless steel and carbon steel sheet/plate in the flat, horizontal, vertical up and down and overhead positions.
- Weld a T-joint with a multiple-pass, fillet weld on aluminum, stainless steel and carbon steel plate in the flat, horizontal, vertical up and down and overhead positions.
- *Weld a butt joint with a single-pass, square groove weld on aluminum, stainless steel and carbon steel sheet/plate in the flat, horizontal, vertical up and down and overhead positions.

- *Weld a butt joint with a single-pass, V-groove weld on aluminum, stainless steel, and carbon steel plate in the flat, horizontal, vertical up and down and overhead positions..278 *SkillsUSA Championships Technical Standards (2002–2004)*
- *Weld a butt joint with a partial joint penetration, single-pass, double V-groove weld on aluminum, stainless steel and carbon steel plate in the flat, horizontal vertical up and down and overhead positions.
- Weld a butt joint with a multiple-pass, V-groove weld on aluminum, stainless steel and carbon steel plate in the flat, horizontal, vertical up and down and overhead positions.
- Weld a butt joint with complete joint penetration, multiple-pass, and double V-groove weld on aluminum, stainless steel and carbon steel plate in the flat, horizontal, vertical up and down and overhead positions.
- Weld 6-inch (150 millimeter) or 8-inch (200 millimeter) diameter and smaller, schedule 40, aluminum, stainless steel, carbon steel pipe, single/multiple pass V-groove weld in the 2G, 5G and 6G positions.
- *Lay out, weld, cut and prepare coupons for evaluation.
- Test prepared coupons.
- Oxygen Fuel Cutting (OFC)
 - *Demonstrate safety procedures for OFC.
 - *Demonstrate ability to correctly set up the OAC equipment for cutting and do basic process troubleshooting.
 - Correctly identify base metal prior to cutting.
 - *Set up and shut down equipment for cutting carbon steel plate.
 - *Select correct tip size and gas pressure for serving carbon steel plate (1 /4 -inch to 1 /2 -inch thickness).
 - Prepare carbon steel for cutting.
 - *Cutting operations will be specified in drawings and procedure sheets provided to the contestants.
 - *Properly light, adjust the flame, and shut down the oxygen fuel equipment.
 - *Use a straight edge and soapstone laying out the prescribed pattern.

- *Make a square cut on carbon steel in flat, horizontal, vertical and overhead positions.
- Make a bevel cut (45-degree angle) on carbon steel plate in the flat, horizontal, vertical and overhead positions.
- *Pierce a hole on carbon steel in the flat, horizontal, vertical and overhead position.
- *Make a pipe and tubing cut on carbon steel pipe in flat, horizontal, vertical and overhead positions.
- Make a gouge and groove cut on carbon steel in flat, horizontal, vertical, overhead positions.
- *Lay out, weld, cut and prepare coupons for evaluation.
- Test prepared coupon.
- Plasma Arc Cutting (PAC)
 - *Demonstrate safety procedures for PAC.
 - *Demonstrate ability to correctly set up the PAC power sources, related cutting equipment and do basic process and equipment troubleshooting.
 - Correctly identify base metal prior to cutting.
 - *Set up and shut down equipment for cutting carbon steel, stainless steel and/or aluminum.
 - *Select correct cutting head and gas pressure for severing carbon steel, stainless steel or aluminum plate and/or sheet (1 /16 -inch to 1 /4 -inch thickness).
 - Prepare carbon steel, stainless steel and/or aluminum for cutting.
 - *Cutting operations will be specified in drawings and procedure sheets provided to the contestants.
 - *Properly adjust and use the plasma arc equipment.
 - *Use a straight edge and soapstone laying out the prescribed pattern.
 - *Make a square cut on carbon steel, stainless steel and aluminum sheet/plate in flat, horizontal, vertical and overhead positions.
 - Make a bevel cut (45-degree angle) on carbon steel, stainless steel and aluminum sheet/plate in the flat, horizontal, vertical and overhead positions.

- *Pierce a hole on carbon steel, stainless steel and aluminum sheet/plate in the flat, horizontal, vertical and overhead position.
- *Make a pipe and tubing cut on carbon steel, stainless steel and aluminum pipe in the horizontal position.
- *Make a gouge and groove cut on carbon steel, stainless steel and aluminum sheet/plate in the flat position.
- *Lay out, cut and prepare coupons for evaluation.
- Test prepared coupon.

Judging Criteria

The contest will be evaluated on the competencies based on the following rating system. The technical committee according to the difficulty of the assigned task will establish point values for each item. Final judging of the welded projects will be evaluated using the following Visual Inspection Criteria:

- Dimensional accuracy, including distortion
- Conformity to drawing requirements, including determination of whether all welds have been completed and whether the finished welds conform to the required size and contour
- Visual examination of the welds for:
 - Cracks
 - Undercut
 - Overlap
 - Craterfill
 - Spatter
 - Arc strikes
 - Porosity
 - Convexity and reinforcement
- Welding equipment may be obtained from a variety of manufacturers and may include transformers, rectifiers and/or inverters.
- Filler metals will be compatible with the metals being welded and will be detailed on the contest procedure sheet. Instructions to the contestants will define more specifically the filler metals that may be used. *Sponsored by Goodheart-Willcox Publisher 279*

ITEMS EVALUATED

(Technical committee members based on the difficulty of the task should assign points)

- Burning
- Layout
- Use of Torch
- Cut Edge Appearance
- GMAW
- Layout and Assembly
- Equipment Setup and Adjustment
- Bead Appearance
- GTAW
- Project Assembly
- Equipment Setup and Adjustment
- SMAW
- Equipment Setup and Adjustment
- Bead Appearance
- OTHER WELDING PROCESSES
- OVERALL DIMENSIONS
- WELD TEST
- OVERALL APPEARANCE
- SAFETY
- WRITTEN TEST
- CLOTHING PENALTY (minus 0 to 5 percent of total points)

Arkansas's All Aspects of Industry

Defining “All Aspects”

All aspects of an industry include, with respect to a particular industry that a student is preparing to enter, planning, management, finance, technical and production skills, underlying principles of technology, labor and community issues, health and safety, and environmental issues related to that industry. Planning is examined at the level of both an individual business and the overall industry. Planning elements might include:

- Developing strategic plans — mission, vision, goals, objectives, and/or a plan of action
- Working with planning tools such as surveys, market research, and competitive analysis
- Anticipating needs for staffing and major purchases of equipment and supplies
- Developing plans for training and upgrading of staff
- Forecasting market trends
- Developing business plans for entrepreneurial ventures.

Management addresses methods typically used to manage enterprises over time within the industry, as well as methods for expanding and diversifying workers' tasks and broadening worker involvement in decisions. Key elements of management might include:

- Using an organization chart to explain how a corporate chain of command works
- Providing input for strategic plans and communicating the company's vision and mission statements
- Leading employees in carrying out strategic plans and action plans
- Evaluating employee performance
- Anticipating technology and other major purchasing needs
- Ensuring equity and access for employees
- Resolving conflicts
- Developing job descriptions and written policies/procedures
- Identifying recruitment procedures, training opportunities, methods of evaluation, and retention strategies
- Working with professional associations and community outreach efforts.

Finance examines ongoing accounting and financial decisions and different methods for raising capital to start or expand enterprises. Finance functions might include:

- Developing budgets
- Preparing financial statements
- Analyzing and managing financial transactions and records
- Implementing payroll procedures
- Determining and paying taxes
- Identifying indirect wage costs (benefits, FICA, insurance, worker's compensation)
- Making loans and granting credit to customers
- Developing graphs and charts related to company finances
- Identifying and implementing methods of sustaining profitability of a business
- Managing 401K plans
- Identifying sources of capital

Technical and Production Skills cover specific production techniques and alternative methods for organizing the production work, including methods that diversify and rotate workers' jobs. Technical and production skills that an employee should have to succeed in a business or industry might include:

- Developing and upgrading job-specific skills
- Using troubleshooting and problem-solving techniques
- Analyzing information to make decisions
- Identifying and implementing quality assurance techniques
- Employing communication skills such as writing, listening, speaking, and reading
- Participating in team efforts
- Implementing projects and new techniques
- Demonstrating basic computer skills; employing time management techniques in completing projects and assigned tasks
- Demonstrating ethical behavior and work ethic.

Underlying Principles of Technology provide an integrated study across the curriculum of the mathematical, scientific, social, and economic principles that underlie the industry's technology.

Principles of technology that an employee should know might be demonstrated by:

- Exhibiting proficiency in mathematical and scientific functions related to new and emerging technologies
- Continuously upgrading job skills needed to implement new technologies
- Participating in industry certification programs
- Cross-training to enhance one's value to the organization and to enhance job promotion opportunities
- Understanding and adhering to ethical issues related to technologies.

Labor Issues examine worker rights and responsibilities, labor unions and labor history, and methods for expanding workers' roles. Labor issues might include:

- Understanding and implementing worker rights and responsibilities
- Working with labor unions
- Keeping abreast of local, state, and federal legislation affecting employee and employer rights and responsibilities
- Negotiating and settling worker disputes
- Identifying certification requirements for specific jobs
- Analyzing the impact of labor agreements on business operations.

Community Issues explore the impact of the industry on the community and the community's impact on and involvement with the industry. Concepts of business and community relations might include:

- Developing and working with community outreach projects
- Participating on advisory committees and community organizations
- Working with professional associations
- Developing and implementing public relations plans
- Participating in community service projects.

Health, Safety, and Environmental Issues examine these concepts in relation to both the workers and the larger community. Concepts related to health, safety, and the environment might include:

- Identifying and implementing federal, state, and local regulations related to the health and safety of employees
- Understanding and strictly adhering to federal, state, and local environmental regulations related to the business
- Identifying job-specific health hazards and safety issues
- Identifying and implementing basic safety and first aid training techniques for emergencies such as personal illness or injury, tornadoes, fires, nuclear accidents, floods, and incidences of employee-rage or violent behavior
- Communicating safety regulations and plans to employees

Working with selected community groups to implement safety programs.

Crosswalk to S.E.N.S.E. and AWS National Standards

The American Welding Society (AWS), recognizing the need for competent entry-level welders, prepared the Guide for the Training and Qualification of Welding Personnel—Entry Level Welder. The AWS standards along with the associated curriculum guides make up the AWS Schools Excelling through National Skill Standards Education

(S.E.N.S.E.). S.E.N.S.E. information is available to any institution as part of the AWS's commitment to provide quality education and training programs based on industry need, and to advance the science, technology, and application of welding. Thus, there exists a natural connection between the Arkansas frameworks, the AWS curriculum guides, and the S.E.N.S.E programs. The following Competency Based Program Outline for the Entry Level Welder Training Program is represented in the Arkansas frameworks. The outline includes:

3.2.1.1 COURSE A: OCCUPATIONAL ORIENTATION

3.2.1.2 COURSE B: DRAWING AND WELDING SYMBOL INTERPRETATION

3.2.1.3 COURSE C: ARC WELDING PRINCIPLES AND PRACTICES

Unit 1: SHIELDED METAL ARC WELDING (SMAW)

Unit 2: GAS METAL ARC WELDING (GMAW, GMAW-S)

Unit 3: FLUX CORED ARC WELDING (FCAW, FCAW-G)

Unit 4: GAS TUNGSTEN ARC WELDING (GTAW)

3.2.1.4 COURSE D: OXYFUEL GAS CUTTING PRINCIPLES AND PRACTICES

Unit 1: MANUAL OXYFUEL GAS CUTTING (OFC)

Unit 2: MACHINE OXYFUEL GAS CUTTING (OFC)-[TRACK BURNER]

3.2.1.5 COURSE E: ARC CUTTING PRINCIPLES AND PRACTICES

Unit 1: AIR CARBON ARC CUTTING (CAC-A)

Unit 2: PLASMA ARC CUTTING (PAC)

3.2.1.6 COURSE F: WELDING INSPECTION AND TESTING PRINCIPLES

Unit 1: VISUAL EXAMINATION PRINCIPLES AND PRACTICES

Welding Technology Framework Cross Reference

Metal Fabrication

Unit 1	Occupational Opportunities in Welding	Duty(s):
Unit 2	Personal and Equipment Safety	Duty(s): A,B
Unit 3	Metal Working Equipment	Duty(s): C,D,E,F,G
Unit 4	Welding Mathematics	Duty(s):
Unit 5	Measuring Tools	Duty(s):
Unit 6	Basic Blueprint Reading	Duty(s): B
Unit 7	Layout	Duty(s): B
Unit 8	Metal Properties	Duty(s):
Unit 9	Welding Information	Duty(s): B
Unit 10	Oxyfuel Cutting Principles and Practices	Duty(s): G
Unit 11	Plasma Arc Cutting	Duty(s): J
Unit 12	The VICA Student Organization	Duty(s): A,B

Shielded Metal Arc Welding

Unit 1	Safety, Symbols and Terminology	Duty(s): A,B
Unit 2	Equipment	Duty(s): C,I
Unit 3	Practices and Principles	Duty(s): C,K,I
Unit 4	The VICA Student Organization	Duty(s): A,B

Gas Metal Arc Welding

Unit 1	Safety, Symbols and Terminology	Duty(s): A,B
Unit 2	Equipment	Duty(s): D
Unit 3	Practices and Principles	Duty(s): D,EK,K
Unit 4	The VICA Student Organization	Duty(s): A,B

Gas Tungsten Arc Welding

Unit 1	Safety, Symbols and Terminology	Duty(s): A,B
Unit 2	Equipment	Duty(s): F
Unit 3	Practices and Principles	Duty(s): F,K
Unit 4	The VICA Student Organization	Duty(s): A,B